AMATEUR RADIO DEFENSE

PUBLICATION OFFICES:
Monadnock Building
San Francisco - California

DECEMBER
1940

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communications

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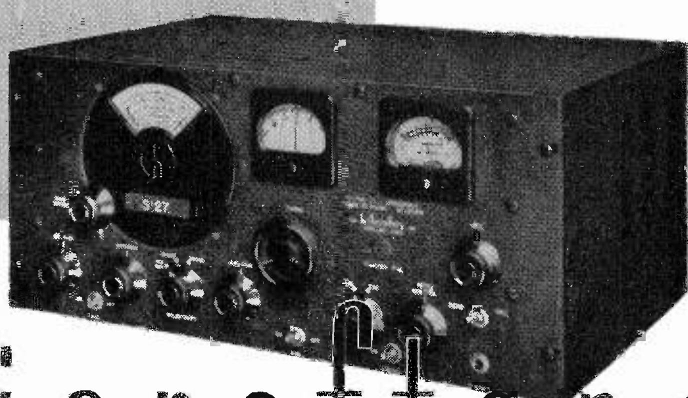
S-27



hallicrafters

VOL. 1 ● No. 2
DECEMBER, 1940

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A.R.D.

AMATEUR RADIO DEFENSE

Published Monthly

By

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In the Interests of

Amateur Radio Defense Association

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CONTENTS FOR DECEMBER

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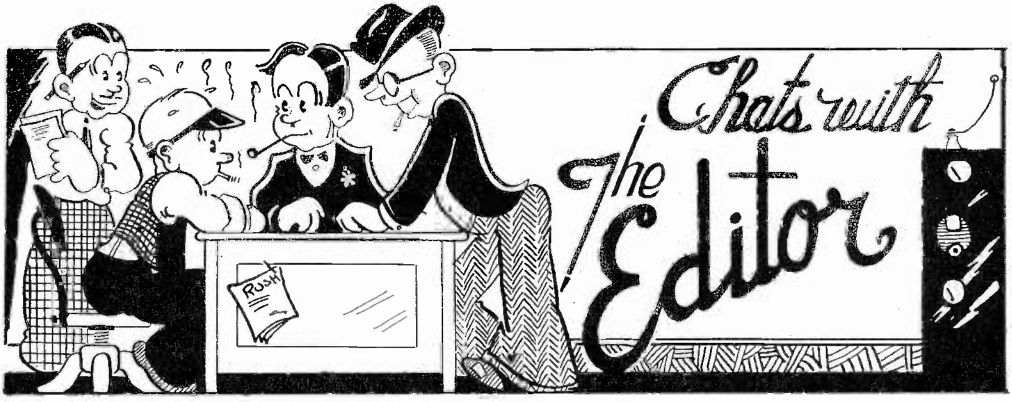


STATISTICS are usually dry and boresome. Not so in the amateur radio field. Here are a few facts of interest: (1) This magazine is one month old. Already it has been favored with subscriptions from amateurs in all of the 48 states of the Union. (2) Every subscriber is an active radio amateur. More than 87 per cent of the subscribers are more than 40 years of age. The oldest is 62 years, and he resides in one of the Southern states. Truly the "old men" of amateur radio, those rightfully entitled to call themselves OM, are subscribing to the magazine. (3) Approximately 17 per cent of the subscribers are engaged in radio engineering, in plants where governmental and commercial equipment is under contract. Many of these engineers have not subscribed to any amateur radio magazine in recent years. They like two things about the magazine, (a) the **Engineering Applications** pages, and (b) the manner in which our editorial staff talks up to the reader.

The old axiom, "A prophet is without glory in his own land," holds more true than ever from a check of our subscription list. Fewer subscriptions have been received from Californians than from residents of any other state. Largest subscription percentage is from Illinois, Indiana, District of Columbia, and from the state of Washington, the latter due to heavy governmental and commercial radio construction activity in the aircraft and shipbuilding industries, where many radiomen are gainfully employed. Every subscriber, to date, is a licensed radio amateur, no matter his profession, trade or business.

•

ONLY one radio jobber in the United States returned his shipment of magazines to us. He was not sufficiently interested in **Amateur Radio Defense** to open the package and inspect the contents. Dozens of other jobbers sent frantic appeals for additional copies.

•

ENROLLMENT applications in **Amateur Radio Defense Association** bring an astounding fact into the limelight—**not more than 3 per cent of the enrollees are members of any other amateur organization!** Bets have often been laid, and without takers, that only 25 per cent of the licensed amateur radio fraternity of the United States has, during any one-year period, been enrolled into the membership of any organization. Perhaps the original estimate may yet prove high. By all odds, a great number of subscribers to an amateur radio magazine will be found among public libraries, commercial operators, military radio operators, prospective amateurs, short-wave listeners, teachers and students. As much as 20 per cent of the total circulation, in some cases, finds its way into foreign lands. Right now this foreign amateur circulation is of no especial value to the American radio manufacturer. None of it has been solicited by the publishers of this magazine. Concentration is in the domestic market exclusively.

•

QUITE a number of readers have asked that we not "feed" television to them in this magazine, claiming that it is hard to digest. One reader wants to make his ham 10-watter work satisfactorily before he experiments with 30-tube television circuits. "I want my money back if you give me television," another subscriber warns, adding that the snakes he sees in his cathode-ray oscilloscope will hold him for a while. Perhaps the announcement in last month's issue, that the editor is the author of **"Television with Cathode Rays,"** prompted these letters. Which proves that East is East, and West is West, and hams are hams, and hams, and hams. The warning shall be heeded, because it has long been an established custom in the newspaper fraternity that if five unsolicited and widely scattered complaints are leveled against a certain feature in the paper, out it goes. In our case, out went television, long before it had a chance to crawl in.

•

WITH defense contracts for radio equipment costing more than eight million dollars awarded a single radio manufacturing plant, with quarter-and half-million dollar contracts going to a half dozen of our best known amateur radio manufacturers, with salary increases and bonuses to many amateurs recently hired by manufacturers, it looks like a "kilowatt in every pot" will be the slogan of the amateur of tomorrow. Many amateurs are now holding down their best-paid jobs of a short and hectic lifetime, and every one of 'em is rubbing his hands gleefully, looking ahead to the super-high-power transmitter he'll have on the air PDQ.

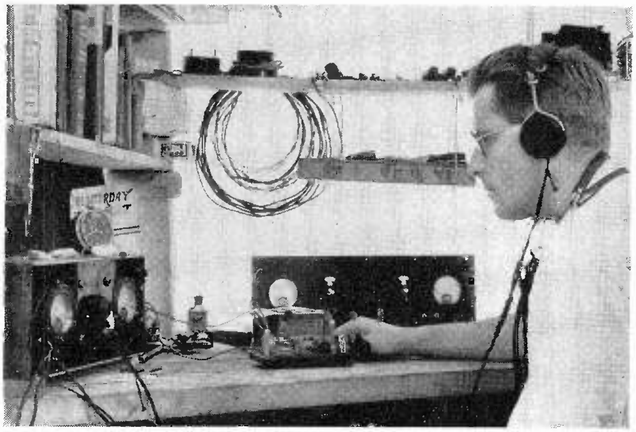
One amateur, applying for a job in a radio tube plant, told the shop foreman that he was willing to work an entire month if he could have just one of those big glass jugs instead of a pay check. The foreman replied (in jest) that he'd rather part with two smaller tubes, which could be connected in push-pull to give the same output as a single, large tube, but the amateur couldn't see it that way—the giant tube it must be, or nothing. This is fact, not **fiction**. But brother ham didn't know that the big glass bottle sold for something like $500.00, and the foreman told us that he had at long last met the first amateur who didn't know what he was worth, either in cash or in trade. **HI!**

QRA's of Staff and Contributors

★

LOUIS R. HUBER
W7CRJ

Our
Newly-Appointed
Associate Editor



HUBER AT KVD
Place: Aleutian Islands, Alaska. Time: 1933. This was KVD, a radio-acoustic ranging station for the U. S. Coast and Geodetic Survey.

AMATEUR RADIO DEFENSE is pleased to announce as an addition to its staff Louis R. Huber, Associate Editor and Northwest Editorial Representative. Huber lives in Seattle, bears the call W7CRJ, and will watch the northern ramparts for us, with special attention to aviation, military, naval and Alaska matters.

Huber's radio experience reads like Yehudi's, the only difference being that Huber actually did it all. The first thing he grabbed after leaving the cradle was a Ford spark coil, which he put on the air in pre-1917 days. He was a licensed radio operator at the age of 13, and the town terror in Tipton, Iowa, when wireless became radio and the BCL's formed a vigilante committee whose aim was the extinction of 9SU. By 1930 he had shifted to Seattle aboard the U. S. Coast and Geodetic Survey's No. 1 radio-acoustic-ranging vessel, the Discoverer, for several seasons' work in Alaska waters, where he became K7AHK. Along the line Huber has recognized the need for Amateur Radio Defense so we find that he is also an Ensign in the U. S. Naval Reserve as of 1929.

Thus far, you no doubt have concluded that the middle initial R. in Huber's name must stand for Radio—but that's just where you're Rong. It stands for "Riting"—one of the three R's—and by 1934 Huber has graduated from the University of Iowa's school of journalism and joined the editorial staff of the Des Moines Register.

Still on the make, Huber by 1937 was in Washington. D. C., as photo editor for the Associated Press Wirephoto bureau. The lad has Seattle and radio in his blood, however, so now we find him working in the Boeing Aircraft Company's radio crew and free-lance-writing on the side. His addition to our staff calls for rapd-fire exchange of communications between Seattle and 'Frisco. The ARD staff is livened almost daily by the bon mots exchanged between Huber and Clyde C. Anderson, our drafting artist, who are still arguing about what the seasick sailor said to the Siwash in Big Port Walter, Alaska.

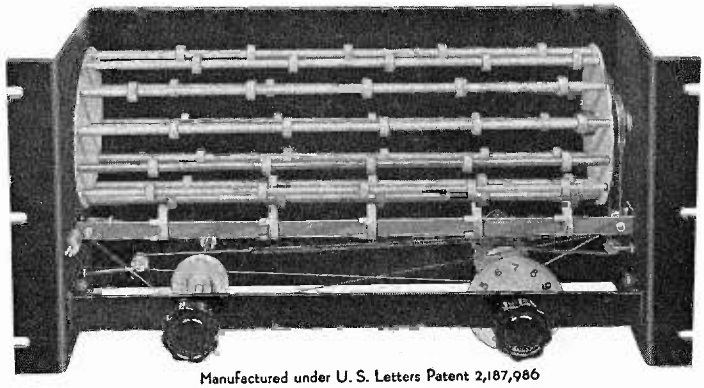
Huber brings a versatility to ARD which is rare in a radio man. Primarily an operator, Huber also has an unique insight into the technical side. He was a pioneer in the development of transmission lines for antennas and the first practical article on an interference-free receiving antenna for four amateur bands was written by him.

Buy Radio Equipment Now

DURING the first World War it became almost impossible to buy a new automobile without paying fantastic prices. In some cases prices advanced as much as 500 per cent, and there came a period when automobiles were assembled from parts, because new cars were unobtainable. Does it not seem reasonable that a similar situation may soon confront us in amateur radio? If war and defense contracts eventually tax the capacity of each radio manufacturer the unfilled demand for radio gear will be enormous. Already one manufacturer has a defense contract for eight million dollars worth of radio equipment. Our advice to the amateur who has a few sheckles in the sock is to invest in a good receiver now, while they are still available. Radio buying for defense hasn't scratched the surface as yet. Watch out when it gets under way in full swing.

If a manufacturer of variable condensers gets a contract for almost a fifth of a million dollars, according to reports, and if it gets caught short and a few million more condensers are needed and none can be supplied, where do you think you will get your condensers? You'll go back to the kitchen sink and cut up the XYL's aluminum pots and pans, and make your own V.C.'s. The war might bring back the horse and buggy age to amateur radio. In the months to come, better keep your eye on the trend. Good receivers may be scarce, and soon the Government may contract for all facilities of all radio plants. Then you can look back and recall these words of advice. BUY NOW!

1 CONTROL for YOUR Xmtr!



Manufactured under U. S. Letters Patent 2,187,986

Introducing the most sensational device in Amateur Radio History

The New Meissner "SIGNAL RESONATOR"

The Meissner "Signal Resonator," pictured above, may be installed in ANY radio transmitter, regardless of size or type of construction. It automatically tunes as many as FIVE STAGES! Provides 110 distinct and AUTOMATIC tuning functions — manually controlled by a single knob!

Just think of it!! 160, 80, 40, 20, and 10 meters, INSTANTLY AVAILABLE by a twist of the wrist! The entire transmitter tuned "on the nose" — regardless of band or frequency! You don't need roller skates to "tune up" a modern transmitter equipped with the Signal Resonator. One Control does the entire job.

Ask your local Meissner Distributor to tell you more about this amazing device. Once you see it, you'll never be satisfied with any transmitter having more than ONE tuning control.

DESCRIBED IN SEPTEMBER *QST*

The Signal Resonator was fully described in an article by Bill Atkins (W9TJ) and Cy Reed (W9AA) on page 30 of the September issue of *QST*. We suggest that you refer to this article for further details.

EXCLUSIVE FEATURES!

★ Automatic, All-Band, Multi-Frequency Transmitter Control.

★ Accurate frequency resonation of any transmitter having from one to five stages.

★ Only ONE control knob for the ENTIRE transmitter.

★ Faster in action than a modern band-switched receiver.

★ Precision-built, fool-proof and positive in action.

★ Dimensions: 19 inches wide, 8½ inches high, 5 inches deep.

Net Price, only.......... $29.50

FREE AMATEUR CATALOG

Send your name in now for your copy of the new Meissner Ham Catalog, listing amateur equipment and parts exclusively. Contains description and prices on many new and interesting products.

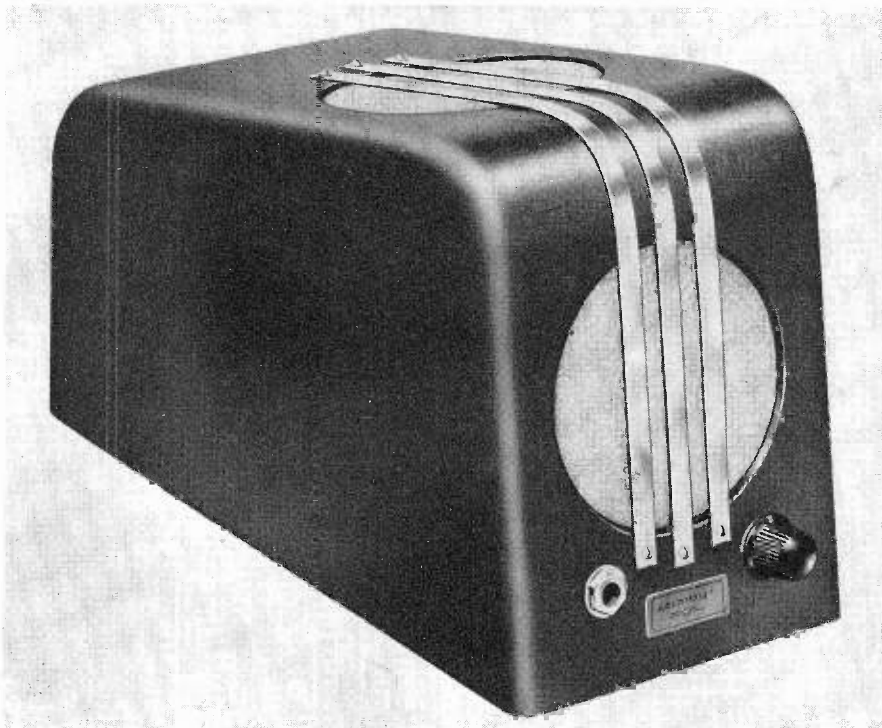
ADDRESS DEPT. AD-12

Meissner MT. CARMEL ILLINOIS

"A FAMOUS NAME FOR TWO DECADES"

Attention C-W Men!

SHIP OPERATORS — AMATEURS



THIS IS THE NEW MEISSNER

"UNI-SIGNAL SELECTOR"

Most Revolutionary Development in Amateur Radio Since the "Rock-Crusher" Was Discarded!

Provides 100% readability—a combination electrical, mechanical and acoustical filter—this amazing device takes up where crystal selectivity leaves off—25-cycle band-width gives super selectivity to any receiver.

Connected in place of a regular speaker, it eliminates the interference without reducing the signal! Tube Hiss is completely gone—QRN, no longer troublesome! QRM is practically obsolete—cuts right through those South American phones!

Can not be used on phone reception—cut over switch on Selector connects standard speaker for phone reproduction. With Selector "ON," you never know the phones are on the air! Peaked at 1000 cycles, all signals come in with the same clear, ringing tone. Absence of back-ground noises makes the weakest signal quite readable.

Get yours now and begin at once to enjoy REAL C-W Reception! Only $13.75 net—once this good news gets around, every C-W Ham will have one. See your Meissner Parts Jobber TODAY!!

ADDRESS DEPT. AD-12

Meissner MT. CARMEL ILLINOIS

"A FAMOUS NAME FOR TWO DECADES"

Charter Members of A. R. D.

John I. Steventon, First Member

THE immortal honor of being first to apply for enrollment in Amateur Radio Defense Association goes to Mr. John I. Steventon, W6CLS, one of San Francisco's pioneer DX record holders. He is also No. 1 subscriber to "Amateur Radio Defense." Immediately upon learning that a new organization was being founded, he rushed his application for membership, not knowing that first honors were to be his. Although many amateurs in other states have requested that they, too, be entitled to first enrollment, there can actually be but one "first." Obviously, those closest to publication headquarters held a decided edge, and so we are listing elsewhere a number of others in the several states to whom full credit must be given for their eagerness and willingness to enroll in Amateur Radio Defense Association. At no time in the long history of our amateur radio publishing activities has such widespread and spontaneous interest been shown by the amateurs.

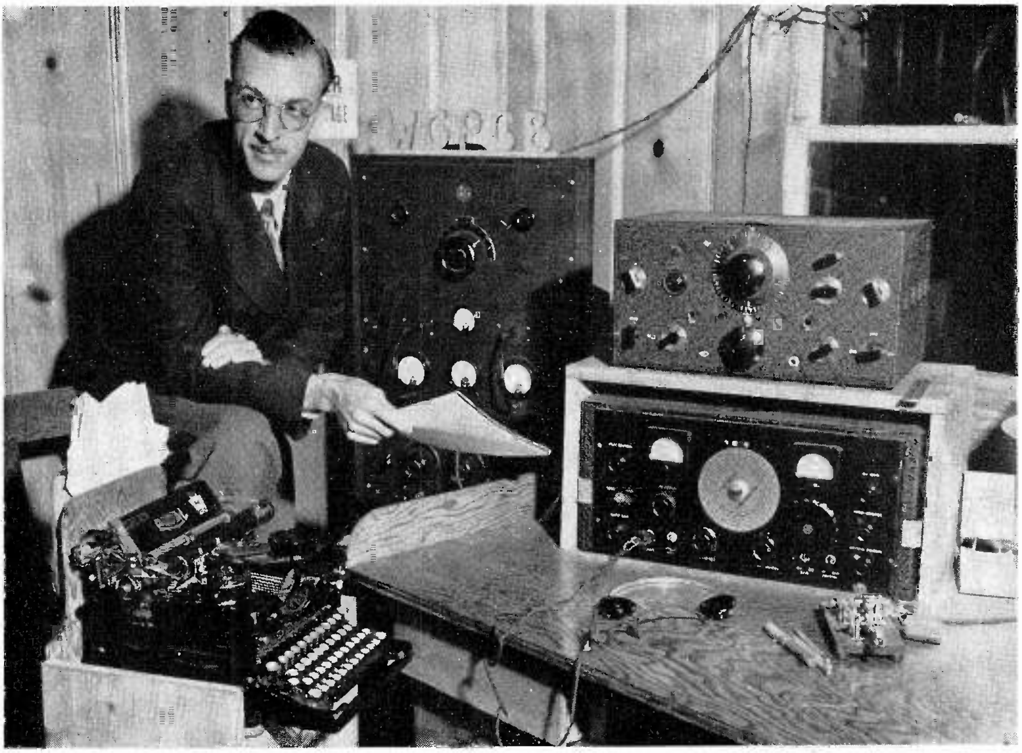
John I. Steventon has been a licensed amateur for almost 20 years. He operates a 1-Kw transmitter, has worked practically all countries (101, by count) on 'phone. He handles traffic, and enjoys it. Was one of the first to develop an electrically-controlled 3-element rotary beam. In the business world he is vice president of San Francisco Milling Co., Ltd. Was married on Xmas Eve, 11 years ago. Has a YL op., 8 months old, and a beautiful blonde YF.

You'll hear W6CLS on the 20-meter 'phone band from his new QTH on top of Telegraph Hill, San Francisco. He is an enthusiastic A.R.D. booster and wants the new organization to forge ahead by leaps and bounds.

* * *

BY a strange coincidence, our first A.R.D. member and subscriber from Southern California is the man who holds the first call in the W6 district, W6AA, C. L. (Roi) Cronkhite of Riverside, California. Roi was an amateur long before the first World War, during the time when he resided at a military post in San Francisco. His father was an officer in the U. S. Army, and the government reservation boasted of an old-fashioned radio station, where young Cronkhite was first bitten by the radio bug. So he decided to make radio his career, and later enlisted in the Signal Corps of the U. S. Army, serving as radio sergeant aboard U. S. Army Transports. He saw active duty in the war zone in convoys, and was later assigned to the transport run between San Francisco and Manila. Truth is stranger than fiction, and the editors will here reveal a strange tale of amateur radio sportsmanship, the likes of which has probably never been duplicated. It happened just after the close of the war. Cronkhite was in charge of the radio station on a transport bound for home, and on this same vessel was W6JYN (just released from service). Staterooms on the transport were unavailable—you slept on deck, below deck, or any other place aboard ship. Cronkhite had a stateroom of his own. Several army officers, also returning home, offered him from $300.00 to $500.00 for the use of his stateroom. But these army officers did not know that W6JYN was aboard, and that Cronkhite and "JYN" were hams. So "JYN" was given use of the stateroom free of charge—and Cronkhite lost an opportunity to make some easy money, quickly. Said he: "I'd rather give my room to a brother ham free of cost, than sell it to anyone else at any price." Thus the true spirit of amateur radio proved itself again. After the war Cronkhite went to Mexico, where he built a number of commercial stations. He was also with Marconi and RCA, at their high power stations on the West Coast. Later he joined RCA Photophone in Southern California, where he is now engaged as Field Supervisor. You'll hear him on the air soon, with a new Kalifornia Kilowatt, and he tells us that he'll hold-on to that pet call of his, W6AA, as long as he lives.


C. L. Cronkhite, W6AA, 1917—and Today



Rex A. Reinhart, W6PGB, is responsible in great measure for many of the salient features of the tentative plan of organization for Amateur Radio Defense Association published elsewhere in these pages. Widely known to traffic men in amateur radio, also in the A.A.R.S. and in the Philippine Express Network, he is also one of the very first to apply for enrollment in Amateur Radio Defense Association. His application followed directly the one from W6CLS, who beat W6PGB to the draw by handing his application in person to W6WB who, in turn, immediately brought it to the offices of the Association. Opined W6PGB: "Had I known that someone else also sought the honor of being the first to join, I would not have sent my application by mail—I would have hired the nearest taxi in order to be the first amateur to arrive at the offices of A.R.D." It was a close race, W6CLS winning by a megacycle. Rex Reinhart is a 40-meter c.w. man and his transmitter operates with an input of 600 watts into a pair of 35Ts. He is 34 years old, married, has a son, owns his own home, and is an executive in one of San Francisco's largest planing mills, owned jointly by himself and members of his family. He has handled more message-traffic than many San Francisco amateurs combined, spends more hours at the key than any other amateur we have known, and is so enthusiastic about amateur radio that he often crawls out of bed in the dead of night to get a few more licks at the key. He has a cozy radio room, arranged in a businesslike manner. Likes his Hallicrafters Skyrider receiver. Copies traffic on the mill. Puts ten-on-a-line. Believes Amateur Radio Defense Association is the most noteworthy movement yet launched, is backing it to the hilt, and persuading scores of his fellow c.w. operators in all parts of the U.S.A. and possessions to join the Association now. Hats off to W6PGB.

. . . From Montana the first enrollment application carries the name of Albert D. Zemanek, W7GVQ of Belt, Montana. Operates a 40-watt transmitter. Has a good academic education and is studying electrical engineering. Is not a member of any other amateur organization. He is chief projectionist and assistant manager of the local theatre, also assistant clerk, part time, at the local post office. Also engages in radio service work. "I am 100 per cent for American ideals," he writes, and pledges to aid Amateur Radio Defense Association in every manner possible.

* * *

. . . From the Bronx, New York, comes an application for enrollment from William D. Tiez, W2LYC, the first New Yorker to offer his services. He is 36 years of age, operates a 100-watt transmitter on 10, 20, 40 and 80 meters, was a Corporal in Headquarters Co., 71st Infantry, New York National Guard, for 3 years, owns direction-finding equipment, and is a member of the A.A.R.S.

. . . From Ohio. the first to enroll is Paul R. Wagner, W8HSW, for 6 years a Radio Sgt. in the National Guard. Operates a 600-watt 5-to-160-meter transmitter, owns direction-finding equipment, and has emergency radio gear for automobiles and planes. He is employed with an Ohio firm dealing in radio parts and equipment. Member A.A.R.S.

* * *

. . . Another National Guardsman is Russell Bernard Smith of Fresno, California, who applies for enrollment. His call is W6ONK, and he operates a 150-watt transmitter on 10, 20 and 40 meters. Is familiar with handling army and navy traffic, is a member of N.C.R. and F.T.S., can copy 35-wpm on the "mill," and is anxious to help Amateur Radio Defense Association in every way possible.

* * *

. . . The state of Washington's first applicant

(Continued on page 10)

Charter Members, Continued

for enrollment in A.R.D. is George Nilson, member of U.S.N.C.R. and a high school student majoring in science Not subject to call in the draft, he is just about ready to take his amateur examination, requesting that he be permitted to enroll in A.R.D. so that he can cooperate with other Seattle radio amateurs and do his part to make the defense program a success.

* * *

. . . New Jersey's first to seek enrollment is James Scairpon, W2KAV, for 19 years in the communications division of the New Jersey Bell Telephone Company. Is a member of the army net, operates a 100-watt 10-to-160-meter transmitter, is a public speaker, and has held an amateur license for 5 years. He is not a member of any other national amateur organization.

* * *

. . . In the same mail which brought a "first" application from Ohio is another from Glenn L. Dallas, W8SRS, of Alliance. He has a 300-watt transmitter and Meissner E.C.O. Is most anxious to get together with other amateurs in his vicinity in order to organize a local unit of A.R.D. Holds membership in no other amateur organization. Is 40 years of age.

* * *

. . . From Massachusetts, Albert S. Sear, W2JNA, is first to seek enrollment in A.R.D. He has a 60-watt, all-band transmitter, also portable equipment. Is a member of the N.C.R. and president of the Worcester Radio Association, a highly progressive organization which sponsors a code class in which 45 students are already enrolled. Mr. Sear tells us that he is a qualified public speaker, anxious and willing to do his part to organize a local A.R.D. unit in his vicinity.

* * *

. . . Pennsylvania's first is Steve Palviscsak, W8SNX, who has a 250-watt 20-40-160-meter transmitter also a 15-watt transmitter in his automobile. Closely following his application was a "batch" of 18 others in the next mail, all from Pennsylvania. But the first honors remain with W8SNX.

* * *

. . . Oklahoma has a brand-new radio amateur, Byron Weldon, W5JFY, who has held his license for two months only, is already secretary of the local radio club, which has 25 members, and his is the first application from his state. He has a 200-watt transmitter which operates on 40, 80 and 160 meters.

* * *

. . . First from Indiana is Wm. J. Quick, M.D., W9OMD, whose application came by air-mail. He has an elaborate radio layout, described elsewhere in these pages, as is a further report on his intense interest in A.R.D.

* * *

. . . Indiana's second to enroll is Harold Gordon Gwinn, W9EMQ, Assistant Postmaster of Anderson. Operates a 400-watt transmitter on 10, 40 and 160 meters. Also has mobile equipment, as well as a "walkie-talkie" 2½-meter job. Has had much experience as coordinator of amateur network traffic, and will be a most helpful member of A.R.D.

* * *

. . . Illinois is represented first by A. David Middleton, W9AOB, nationally known writer of radio fiction, radio engineer with Standard Transformer Corporation, expert code instructor, and an ex-CRM in the U.S.N.R. Copies 35-wpm on the typewriter. Operates a 175-watt transmitter on 20, 40 and 80 meters. Is 35 years of age. Holder of ORS certificate . Anxious to get A.R.D. going in his vicinity.

. . . Iowa's first is Louis Eugene Seevers, Jr., W9AXD, veteran of the first World War. He is 38 years of age, says he is a darned good op., and proud of it (who wouldn't be?), is an experienced public speaker, and operates a 25-watt 40-meter transmitter. Has been a licensed amateur for 20 years.

* * *

. . . First applicant for enrollment from Texas is Arthur William Chambers, W5IYC, an amateur for 21 years, with the Signal Corps for 3 years, and at present a radio merchant. He is 36 years old and operates an all-band 60-watt transmitter. Has never belonged to an amateur organization.

Letters from Members

. . . "Congratulations on your new magazine Amateur Radio Defense. It is well edited and well balanced. In my opinion there was room for another magazine devoted exclusively to 'Amateur Radio.'

"You may be interested to know I have talked with several amateurs here in Detroit and the magazine is meeting with their approval; so more power to you and your staff for a bigger and better magazine than any now being offered to the Amateur Fraternity." **Harold E. Taylor.**

* * *

. . . "Count upon me for full cooperation. Amateur Radio Defense Association should be made the most formidable organization in America. I am persuading many amateur friends to join. Here is my application, also a subscription to the new magazine. It's tops." **S. C. Van Liew, W6CVP, President, San Francisco Radio Club, Inc.**

* * *

. . . "It appears to me that this will be a fine movement for the commercial operator as well as for the amateur operator, and the so-called 'minute man.' Please enter my subscription to the magazine for one year." **W9WEY.**

* * *

. . . "I feel certain you will resume your former niche in the hearts of the amateurs." **P. S. Lucas, Remler Radio Mfg. Co.**

* * *

. . . "I am interested in any periodical with which Frank C. Jones is connected." **Wm. J. Quick, M.D., W9OMD.**

* * *

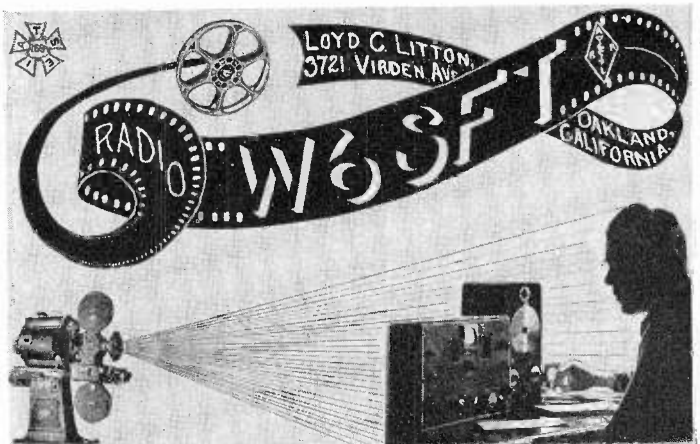
. . . "Like your magazine very much. Let's have a separate page for coupons. I want to join A.R.D. but refuse to cut up the swell picture of James Lawrence Fly." **Charles Stuart, W8TZO.**

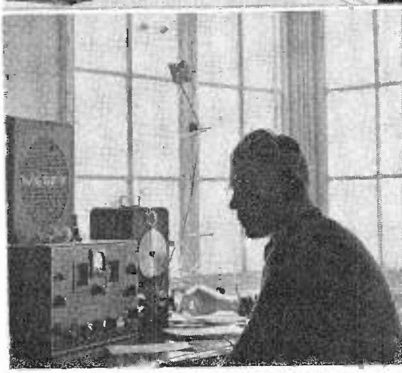
* * *

. . . Our radio club has been discussing just such activity as A.R.D. proposes to undertake. We wish to take action locally, and extend our praises." **W. G. Darrall, AARS-W8CPE.**

* * *

. . . "It's about time someone had courage to come forward with a plan like A.R.D. Count me in immediately." **R. H. Browne, W6AHH.**





W6SFT

• Loyd C. Litton is Oakland's first applicant for enrollment in A.R.D. He lost no time in filing his application, bringing it to Headquarters in person. He has been an amateur for a few months only, but he started right by first buying a good receiver and frequency-meter-monitor. The transmitter is so small it had to be shown in a separate photo, above. It's a one-tube Jones Oscillator, with an RK-49, and with which he has worked KA1HQ, K4ESH, K7HVL, K6-RQO, and all U. S. Districts.

Photos Wanted

PHOTOGRAPHS of A.R.D. members, their equipment, antennas, and any pictures of unusual interest are solicited for publication. Every member would like to know what the other fellow looks like, and what he is using. All photographs will be returned in perfect condition after the cuts are made. Furthermore, the cuts will be given you, without cost, after the magazine is off the press, and you can use these cuts for QSL card, letterheads, or for any other purpose. Unusual QSL cards will also be shown; send them to us for publication. Let us know what you are doing in order to get an A.R.D. unit established in your vicinity, and send names and call letters of all who join your local unit. Keep us posted on your activities and appoint yourself a local correspondent in order to keep us supplied with a continuous flow of copy to print in these pages.

Message Blanks and Stationery

• New Amateur Radio Defense-O-Gram message blanks will be ready by December 5th. These blanks are striking in design and appearance. Although it was announced in our last issue that these blanks will be supplied to you at cost, it has now been decided to supply all Local Communication Officers with these blanks free of cost.

* * *

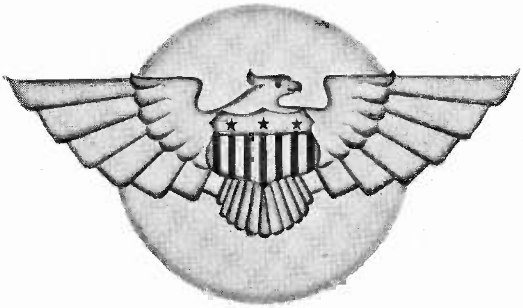
• Official stationery with the insignia of A.R.D. and the imprint of your name, address and title will also be supplied without cost. As soon as you have established a local unit, please get in touch with us so that supplies can be sent.

12,000 Members Wanted

AS amateur radio organizations go, it is safe to assume that one licensed amateur in five is a member, no matter what the organization, no matter how large. True figures, or any statistics by mail poll, have never been made known. It has long been feared that the pitifully small percentage of U.S. licensed radio amateurs who are organization members would discourage others from joining such organizations. We do not agree, in fact, we believe to the contrary.

If, for example, there be 60,000 licensed U.S. amateurs on the rolls by the end of this year, one in five would be 12,000, which is still a very healthy proportion. In fact, it is just such a portion that AMATEUR RADIO DEFENSE ASSOC. strives as its ultimate. This is of greater import because our members are those not subject to the draft, and they will stay at home, buy merchandise, keep the wheels of industry turning in radio plants, shops and stores. So, then, if we achieve the top percentage we will be well satisfied.

The reason why no statistics are ever given out and why no polls are taken by mail and turned over to independent staffs to check is plain. It is feared that memberships will be retarded. We disagree. The time has come for all men to honestly face the facts, no matter how sour they are. If 75 per cent of the U.S. licensed radio amateurs are utterly without representation, it is high time that we did our share to organize thousands of them into the kind of an organization which they can support.



Special Announcement

Complaints have been received from many jobbers and dealers who sell copies of AMATEUR RADIO DEFENSE to their customers. It seems that our former price of twenty cents per copy created undue confusion among buyers and sales clerks, the customer usually paying twenty-five cents for his copy, through force of habit, because most radio publications sell for this price. This has necessitated refunds, which confuse the dealers' sales records, and we have been urged to adopt the accepted price of twenty-five cents for this magazine, thereby creating a standard of uniformity. Consequently, we have enlarged the magazine to 84 pages in order to give you full value for your money. Any reader can subscribe for one year at the old rate of $2.00, which represents a saving of $1.00 over and above the cost of copies purchased singly, but this low price will remain in effect during December only. The increased size of the magazine and the exceptionally high standard of editorial content will positively result in a shortage of copies in retail channels. Protect yourself against missing a single issue of this fast-selling magazine by subscribing now.

* * *

This Coupon Should Be Mailed Immediately

PACIFIC RADIO PUBLISHING CO.
Monadnock Bldg., San Francisco, Calif.

I want to save a dollar. Send "AMATEUR RADIO DEFENSE" for one year. $2.00 is enclosed. Start my subscription with the January, 1941, issue.

Name..

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THE great popularity of the "HQ-120-X" among leading amateurs and engineers is the direct result of its superb performance. When Alan Eurich selected the "HQ" for the Morrissey's main receiver, he was playing safe. The enviable reputation of Hammarlund receivers accounts for their use by many expeditions and in many important government services. The Byrd Expedition, for example, with which the Morrissey communicated on a more or less schedule basis, uses Hammarlund receivers entirely. There is little we can say about the "HQ" that would be as convincing as an actual demonstration. Visit your local jobber—there you can see and operate the "HQ-120-X." Take particular notice how effectively each control functions. Its accurately calibrated band spread dial, antenna compensator, and variable crystal filter are just a few of the features which make the "HQ" an outstanding amateur receiver.

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The Editor's CQ

Let's Go!

CONSIDER the proposed plan of organization for Amateur Radio Defense, as printed on the page following this. As an organization pledged to aid the President of the United States and the national defense, it is headed by the Secretaries of War and the Navy, who finally approve all defense measures. The heart of the organization is an Amateur Radio Defense Board, acting under orders from the Federal Communications Commission. Reporting to the Board are nine Area Communication Officers, one for each of the nine amateur radio call areas in which they function. Acting under each ACO are the State Communication Officers, corresponding to the forty-eight states and possessions, and acting under each SCO is an appropriate number of Local Communication Officers to direct the work of members of Amateur Radio Defense Association in their localities.

PROPOSED PLAN

This diagram graphically presents the bare-bones of an organization which is to be clothed with the flesh, blood, and consciousness of a living body of patriotic amateur radio operators. Its only really novel feature is the Board, upon which this discussion is focussed, and concerning which constructive criticism is invited from readers. The proposal is the consensus of thousands of amateurs who originated and have discussed it over the air and at club meetings, and many of whom have written their views. Grateful acknowledgment is here made to this enthusiastic response to our last month's "Call to Action."

With such widespread agreement as to the need for an effective agency to represent the amateur and as to the method for accomplishing it, there remains the moot questions as to Board personnel and means for support. With regards to these there is a natural difference of opinion which should be settled before the plan can be adopted without fear of drastic changes in the future.

As a basis for discussion, a three-man Board is suggested, consisting of one naval radio expert, one army radio expert, and one experienced civilian amateur radio operator, all to be appointed by the President and confirmed by the Senate. This Board will supervise and coordinate the activities of the Amateur Radio Defense Association and other organizations having a similar purpose, and will be the official representative of more than fifty thousand licensed operators. As two members of the Board are already under Government pay and the third may be a "dollar-a-year man" during the defense emergency, there need be no expense for salaries, other than clerical. All administrative costs could be kept under $50,000 annually without impairing the Board's usefulness.

This sum could be raised by a voluntarily-assumed license fee of one dollar per year to be paid by each licensed operator during such time as the national defense needs his active aid. Such payment is not for the privilege of operating a radio transmitter but to provide a fund to support the work of the Board in protecting the nation from the results of possible disaster to commercial communication facilities and in increasing the scope of amateur activities.

So many arguments have been advanced in favor of such a license fee that we would like to hear particularly from those who might be opposed to it. It has been compared to fees which are paid for licenses to fish, hunt, or drive a car. It is hoped to be temporary in character and to be revoked when no emergency exists to justify it. What are your ideas about financing the Board's work?

Bear in mind that membership in the Amateur Radio Defense Association is free to all licensed amateurs who enroll. The Association has no income from initiation fees, dues, sale of magazines, books, badges, etc. It is as independent of this magazine as it would be of an advertising agency employed to counsel and publicize its activities. None on the staff of the magazine is eligible to office in the Association or on the Board.

Consequently, both the Association and the magazine can appear before Congress with clean hands when influencing legislation favorable to the radio amateur. For Congress makes the laws which the FCC administers. Furthermore, the magazine does not hide behind a K.K.K.-like mask of tax exemption which legally forbids an open effort to influence legislation, a privilege which belongs only to a taxpayer. An independent Association and an independent magazine, actuated by a common objective, can get results.

In the light of these facts, let us know your reaction to the plan. If you approve, either volunteer your own services or nominate another good man to act as temporary A.C.O., D.C.O. or L.C.O. so that there may be no delay in putting the plan into effect. If you do not approve, send in your objections so that the valid ones can be incorporated into the final plan, which will be mailed to all Association members and nominees prior to publication in these columns. In the immortal words of anonymity, "let's go!"

How to Organize a Local A. R. D. Unit

AMATEURS must take it upon themselves to organize local defense units *quickly*. If you are a progressive amateur, appoint yourself temporary leader of the drive in your city or community. Call together as many able amateurs as possible. Hold a meeting. Appoint a temporary L. C. O. (Local Communication Officer) as your chairman. Send his name to us, so that it can be published in an early issue of this magazine. Also send us a list of those who join the movement. If they have not as yet filled-in their application for enrollment in Amateur Radio Defense Association, request that they do so without delay. Membership Certificates will be ready for issuance as soon as authority to release these, with proper signatures affixed, has been granted. Do not wait for these Certificates; get started now!

When you have secured a reasonable number of Amateur Radio Defense members in your local unit, make it a practice to hold meetings at least twice each month. Send a transcript of the minutes of each meeting to us, so that we can publish any new and valuable decisions on the part of your membership, in order that others can profit from your actions.

Once organized even with a small, efficient group of men, contact your nearest army and navy headquarters, and register the names and addresses of your membership with the Commanding Officer. We will supply copies of this magazine to all military agencies in order that they will be constantly informed of our progress.

Contact your civic administration and also place the name of the organization and the list of members on record.

Confidential information will be mailed to all local units of Amateur Radio Defense Association, and this information will not be published in the pages of this magazine. For this reason we request that you inform us at once as soon as your local unit is organized, even if only a very few men are members at the present time. Your membership rolls will grow quickly, once the purpose of this defense campaign is made known to others.

We will supply your local officers with official stationery, free of cost. This stationery carries the emblem of our new organization. Message blanks will also be supplied free of cost. No dues are to be charged, because there will be no need for financial resources. It's expert man-power that is needed now, and patriotic cooperation on the part of men who value their stake in amateur radio.

Inform prospective members that Amateur Radio Defense Association is free to act legislatively in their behalf. Amateur Radio Defense Association can give you the kind of help needed, by soliciting it from the only agency empowered to protect our interests —the Government of the United States.

Application for Enrollment

In

Amateur Radio Defense Association

★ ★ ★

PATRIOTICALLY pledging my service to the radio defense of the United States of America, I hereby apply for enrollment in the *AMATEUR RADIO DEFENSE ASSOCIATION*. I agree to keep my radio equipment in good working order, ready to meet emergencies which may arise as a result of foreign aggression or other catastrophies. I agree to participate in such tests and training in preparedness to meet disaster to normal communication facilities as may be asked of me, provided that I am not then engaged in other work which I deem more essential to my personal welfare.

IN RETURN for my pledge of service, I am to receive a Certificate of Enrollment in the *AMATEUR RADIO DEFENSE ASSOCIATION* and am to be advised, by radio or otherwise, of the activities of said association, all without financial obligation on my part. It is mutually understood that the costs of printing and mailing the Certificate of Enrollment will be borne by the Publishers of the magazine "*Amateur Radio Defense*," who pledge themselves to publicize the Association activities, to print technical information which will improve the practical effectiveness of my equipment, and to seek greater recognition for the amateur radio operator as a means for aiding the national defense.

Pledged at.., ..., **on this**....................
Town State

day of.., **194**....

Witness
....
Enrollee..

Full Name..
Complete Address..
Call Letters..When Received..
Age..Race or Color..
Code Copying Speed (1.. in Handwriting.............................. (2) On Typewriter..............................
Present or Past Employment in Commercial Radio..
Army or Navy Service..
Present Station Equipment: Power..............................Operating Bands..............................
C. W.?..............................Phone?..............................ECO?..............................
Antenna Type.............................. Receiver Type..............................
Measuring or Direction-Finding Equipment..
Academic Education:..
Mobile Equipment (auto, boat, plane)..
Public Speaking or Writing Ability..
Nautical Instruments Owned ....
Membership in Other Communication Networks..
Organization Experience and Willingness to Enroll Others..
Other Special Qualifications..
....
....

The above information is needed for guidance in classification for specialized services. Please write it in detail and mail it to

AMATEUR RADIO DEFENSE,
Monadnock Bldg., San Francisco.

A handsome Certificate of Enrollment will be mailed free to each licensed amateur radio operator who requests it.

NEWS from WASHINGTON

GOOD NEWS FOR AMATEURS

THE Commission adopted an order, effective October 15, 1940, extending in no event beyond April 1, 1941, all amateur radio station and amateur radio operator licenses which have expired or will expire during the period July 1, 1940, to March 1, 1941, and for which applications for renewal have not been granted or denied prior to the effective date hereof. This extension is granted only to such amateur licensees as have submitted or do submit a proper application for renewal in accordance with the Rules and Regulations of the Commission and have complied or do comply with the requirements of Commission Order No. 75; and, further, this extension shall not apply to licensees whose licenses have been or, prior to March 1, 1941, may be revoked, suspended or designated for hearing.

* * *

Effective Date of Section 9.71 of the Rules Deferred

The license terms of all existing airport control stations was extended for three months, from March 1, 1941, to June 1, 1941. This action was taken because of certain questions which have arisen with respect to the use of high frequencies for this service, as well as complaints received concerning the hardships that may result from the rule in some instances, and the effective date of the rule is postponed to allow time for a thorough review of the question.

Procedure for Examination of Standard Broadcast Applications Revised

THE Federal Communications Commission announced that its procedure for examination of standard broadcast applications by the staff departments has been revised with a view to more orderly and expeditious handling. Provision has been made for the consideration of these applications simultaneously, as far as possible, by the technical departments. The methods of operation of each of the individual units responsible for the review of applications is also being studied with a view to speeding up the work.

The Secretary of the Commission has been directed not to regard applications as formally filed with the Commission until they are in his hands, duly executed, and complete with respect to the answering of all required questions. Under the new procedure, an acknowledgement card will be sent to the applicant immediately upon receipt of the application. If it is necessary to return the application for the correction of formal defects or to enter into correspondence with the applicant with regard to correcting his application in respect of any matters of form, the applicant will be notified that his application is not in form for consideration by the Commission and that the application will not be shown on the records of the Commission as officially filed until the formal defects specified in the letter of notification have been corrected. Upon the return of the application in proper form, a file number will be assigned and the application will take its place in the regular order for consideration.

* * *

"National Defense and the Federal Communications Commission"

Extracts from transcription talk by Chairman James Lawrence Fly in Program No. 5 of the "National Defense Series."

THE coordinated program for insuring our national defense has required the Federal Communications Commission to enlarge its activities in some important respects. I might summarize the Commission's main role in the preparedness picture by saying that its particular duty is to "police" the air—and to do it effectively. This, of course, it has been doing on a smaller scale for many years.

This means listening-in and otherwise keeping watch on all forms of radio transmission. It is done by means of what engineers call "monitoring." Stations for this purpose are located at strategic points throughout the United States and its possessions, and are equipped to monitor all forms of radio messages.

The routine work of the FCC covers licensing and supervision of all forms of communication by means of electric impulse.

In addition to the familiar broadcast programs, there is commercial point-to-point radio service, and radio transmission by amateurs, aircraft and aero stations, ships and coastal stations, police and fire departments, forestry stations, various types of experimental services, and, on occasions, by special emergency stations. These and other radio transmissions are all under Commission jurisdiction and subject to being adjusted to meet any emergency. The Commission must continually watch the many different types of transmissions to see that they are in accord with the public interest. It now has the added duty of seeing that these transmissions do not run counter to our neutrality or national defense requirements.

All radio transmission is required to be licensed. It is also assigned certain channels, called frequencies, on which to travel. Hence, the broadcast bands can be likened to highways, and the stations and their identifying call letters to automobiles with license tags. Just as an auto cannot cross the white line without risking collision, a radio transmission can't deviate from its set course without causing interference to other signals. Unauthorized or reckless driving on the ether ways is immediately noted by the Commission's monitoring stations, or reported by other broadcasters.

The monitoring stations determine the bearings and characteristics of unauthorized or questionable transmission. And supplementary mobile equipment, usually autos equipped with direction-finding and field strength measuring apparatus, trace the origin of such signals. Under certain conditions it may be necessary to watch a suspected house or other building for a period of time. In such cases the equipment can be removed from the car and operated from the power supply of a rented room, tourist cabin, or other place used for observation purposes.

The Commission wants to be fully and accurately informed about the hundreds of thousands of persons who operate apparatus capable of far-flung and almost instantaneous communication. The Commission, of course, licenses only citizens for all classes of radio transmission. In normal times it has depended upon the applicant's own statement as to that fact. Now, however, it is requiring all radio operators—commercial as well as amateur—to furnish documentary proof of citizenship, as well as fingerprints and photographs for identification record.

With the cooperation of the private wire and cable companies, which handle a considerable volume of official dispatches and other Government messages, it is compiling similar data with respect to their operators. The Communications Act of 1934 charges the FCC with regulating all interstate and foreign communication by electrical means, and this includes telephone, telegraph, and cable, as well as radiotelephone and radiotelegraph.

In June the Commission issued an immediate ban on amateur radio communication with foreign countries, and further prohibited the use of portable long-distance transmitters by amateurs. At the same time, the Commission warned all ship radio operators to refrain from superfluous conversation on the air.

International agreements specifically prohibit the transmission of "superfluous, unnecessary or unidentified communications." If this is a necessary requirement in normal times you can see how essential it is in a period of emergency. While offhand it might seem unimportant for a ship radio operator with time on his hands to chat with other stations, it takes on a different light if, in so doing, he mentions, say, that he is watching troopships moving on the horizon. This can have serious consequences, particularly if belligerent warcraft chance to be listening in. In addition to augmenting its monitoring and inspection duties, the Commission's field force is required to also watch radiotelephone and radiotelegraph circuits for superfluous messages and, if necessary, record the same for possible use as evidence.

An incidental task of the Commission's field staff is to guard against possible misuse of certain types of electrical apparatus. Even the diathermy devices now employed so usefully in many doctors' offices are capable of sending out signals that, under certain circumstances, might jeopardize the national security. Still another undertaking along these lines is to maintain a check on transmitters that have been manufactured but which have not been licensed for communication use.

In times like these our investigations of alleged unauthorized use of radio have increased tremendously over the thousand or so cases we had last year. The American public is not naturally "Fifth Column" conscious. Every antenna on a coastal fisherman's shack or a mountain cabin is a potential "spy" outfit in the eyes of some observing citizens under the present situa-

(Continued on Page 74)

Best Vaules for Tuning Capacities

Given by Remarkably Simple Charts and Formulas for Plate-, Grid-, and Cathode- Modulated R-F Amplifiers, C.W. Push-Pull Amplifiers, Parallel-Tuned Antenna Circuits and Link-Coupled Grid Circuits

By Frank C. Jones, Technical Editor

THE operating efficiency of any tuned r-f amplifier, as well as that of a tuned antenna circuit, can be greatly improved by maintaining a proper L/C value for resonance at any desired frequency. Selection of the proper ratio also greatly minimizes the output of undesired harmonics from an r-f amplifier. The correct value for the capacity, corresponding to a given Q for the amplifier, can be readily calculated from the general formula

$$C = \frac{Q}{\omega Z} = \frac{K}{fR_p}$$

where K is a constant whose value depends upon the type of circuit, f is the frequency, and Rp is the plate resistance of the amplifier tube.

Values of C for various circuits are herein presented, after the validity of the formula has been proved. Furthermore, a series of charts showing the proper values of C suitable for the amateur wave-bands is also presented for the benefit of those who prefer charts to formulas.

The formula is based upon the practical fact that an L-C circuit must have sufficient fly-wheel effect to furnish a sine-wave output to a load circuit during the time that the instantaneous plate current is zero. For example, the plate current flow from a Class-C amplifier is zero for about two-thirds of each r-f cycle, assuming that it is operated with a plate current flow of 120-140 degrees. The plate current pulse supplies a surge of power to the L-C circuit consisting of a coil and tuning condenser in the load circuit, whether it be the plate circuit of another amplifier stage or the antenna circuit. When the L-C load circuit is properly designed, it stores power for about one-third of the time and restores or furnishes power for about two-thirds of the time of each cycle.

The fly-wheel effect depends upon the ratio of r-f volt-amperes to the Q of the circuit, and should be not less than $4\pi = 12.56$ for a single-tube Class-C amplifier stage. For a Q of this value, one-half of the energy stored in the L-C circuit is absorbed in the antenna and less than 5% of the harmonics are radiated. When Q is greater than this correct value, the circuit losses are excessive, due to the larger current flow.

The L-C circuit efficiency can be expressed by the ratio

$$\frac{Q_o - Q}{Q_o}$$

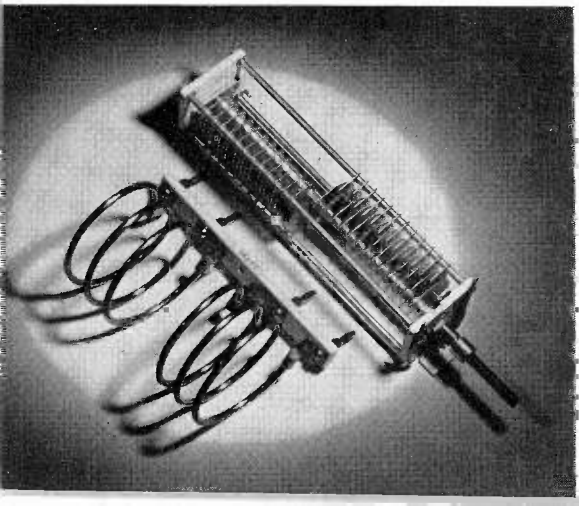
where Q_o is the value for the unloaded L-C circuit and Q is the value for the circuit under normal load. For example, if $Q_o = 150$ and an antenna circuit reduces the value to 15, the efficiency of the entire circuit is

$$\frac{150 - 15}{150} = 0.9 = 90\%.$$

Should the same amplifier be operated with a circuit Q of 30 the efficiency would be

$$\frac{150 - 30}{150} = 0.8 = 80\%.$$

Since $Q = \frac{\omega L}{R} = \frac{2\pi fL}{R}$, the efficiency is seen



to depend primarily upon the value of R, the resistance in series with the inductance and capacitance.

With a low-loss coil and a condenser not loaded by an antenna circuit R is very small. It is increased by coupling an antenna or grid circuit of a following amplifier or doubler stage, inasmuch as such a stage acts as a resistance in parallel with the series resistance.

The Q can be changed to any value from 3 to 100 by varying the antenna coupling. With a single-tube r-f amplifier this value should be about 12 for good c.w. operation and about 20 for plate-modulated service. With the proper L/C ratio for the specified operating frequency, these values of Q can be obtained for normal values of d-c plate current in the amplifier tube.

To obtain maximum r-f power output from a Class-C amplifier tube connected across the entire tuned circuit, the impedance, Z, of the tuned circuit should be equal to the plate impedance of the tube.

If the tube be connected across one-half the tuned circuit, as in a single-ended plate-neutralized amplifier, the circuit impedance should be four times as great as the tube impedance.

To determine the a-c plate impedance of the tube in terms of its d-c plate current I_b we can write

$$Z = \frac{E_{ac}}{I_{ac}} = \frac{E_{ac}}{kI_b}$$

where the value of $k = I_{ac}/I_b$ depends upon the amount of grid excitation and varies from 1.57 for an 180-degree angle of plate-current flow to 1.9 for an 80-degree angle as indicated in the following table:

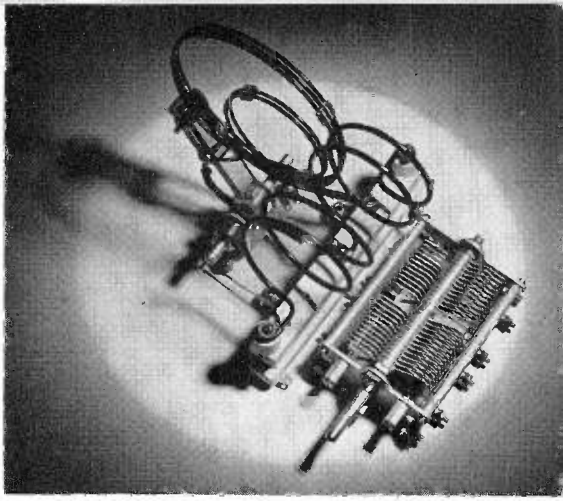
Angle	k	Angle	k
180°	1.57	120°	1.794
160°	1.65	100°	1.854
140°	1.725	90°	1.905

This table provides a convenient means for finding the a-c peak plate current of an r-f amplifier in terms of the easily-measured d-c plate current.

Capacities for Plate-Modulated Amplifiers

THE a-c peak plate voltage, E_{ac}, in terms of the d-c plate voltage, E_b, can readily be found for any specific case. For example, when the plate circuit of the tube is connected across the entire L-C circuit, the voltage E_{LC} across L and C is equal to E_{ac}, whence the impedance of the tuned circuit becomes

$$Z = \frac{E_{ac}}{I_{ac}} = \frac{E_{LC}}{kI_b}$$



Where $k = I_{ac}/I_b$. By assuming a plate circuit efficiency of 72% and designating the power input by W_i and the power output by W_o, we have

$$W_o = 0.72 \quad W_i = 0.72\, E_b I_b.$$

Knowing that the antenna absorbs half of the energy stored in the L-C circuit, and letting $k = 1.8$, whence $I_{ac} = KI_b$ we can also express the power output by

$$W_o = \frac{E_{CL} \cdot I_{ac}}{2} = \frac{E_{LC} \cdot (1.8 I_b)}{2} = 0.9 E_{LC}\, I_b$$

whence we have

$$0.72\, E_b . I_b = 0.9\, E_{LC} . I_b \text{ or } E_{LC} = 0.8\, E_b$$

The plate circuit impedance is, consequently,

$$Z = \frac{E_{LC}}{I_{ac}} = \frac{0.8E_b}{1.8I_b}$$

$$= 0.443 \frac{E_b}{I_b} = 0.443 R_p$$

or slightly less than half the d-c plate resistance.

Since R is small in comparison with the reactive component of the circuit impedance, we can write $Z = L/CR$, where $L = QR/\omega$, as obtained from the definition $Q = \omega L/R$. Then, upon equating Z for its value of Rp, we can write

$$Z = \frac{L}{CR} = \frac{QR}{\omega CR} = \frac{Q}{\omega C} = 0.443 R_p$$

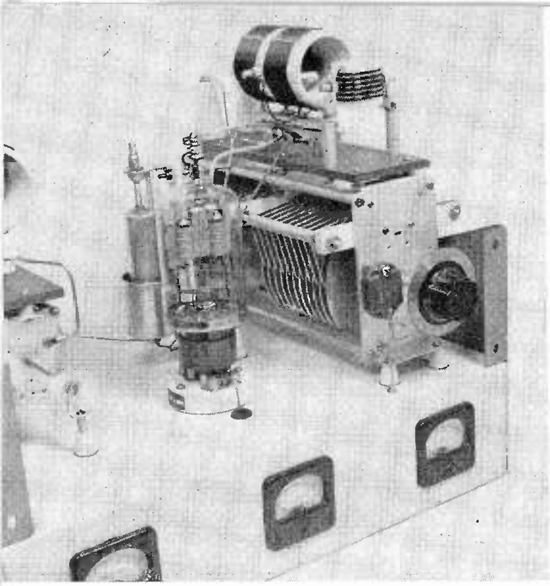
whence we finally have

$$C = \frac{Q}{\omega Z} = C = \frac{Q}{.443 R_p \omega} = \frac{Q}{.886 \pi f R_p}$$

When 20 is specified as the proper value for Q and C is expressed in micro-micro-farads and f in megacycles, we thus have

$$C = \frac{7{,}200{,}000}{f R_p} \mu\mu f.$$

as the proper value for the capacitance in



Typical Plate-Modulated R-F Amplifier with new Eimac 152TL triode. E. F. Johnson Inductances with Rotatable Coupling Coils are illustrated. Cathode-Ray Oscilloscope Pickup Coil also is shown.

the tuned circuit associated with a grid-neutralized or screen-grid amplifier designed for plate modulation.

When the tube is connected across half of the tuned plate circuit, and Z is thus 4 times as great, the formula becomes

$$C = \frac{1{,}800{,}000}{fR_p} \mu\mu f.$$

In a push-pull amplifier each of the two tubes operates during each r-f cycle. There are thus twice as many pulses of plate current as in the case of a single-tube amplifier. This permits the circuit Q to be half as great, or 10. For this case

$$C = \frac{900{,}000}{fR_p} \mu\mu f.$$

The total tuning capacities shown in Fig. 1 for a plate-modulated push-pull amplifier cover the amateur 'phone band frequencies of 2-, 4-, 14- and 28-mc. The chart can be used by dividing the d.c. plate voltage by the desired value of d.c. plate current in order to obtain a value for Rp as plotted on the vertical scale. A typical example is a pair of tubes operating at 1,500 volts plate supply and 300 ma. plate current, whence

$$R_p = \frac{1{,}500}{.300} = 5{,}000 \text{ ohms}$$

In Fig. 1 the proper tuning capacity can be found by placing a straight-edge along the 5,000-ohm resistance value until it intersects the slanting line at the desired frequency of operation, thence down vertically

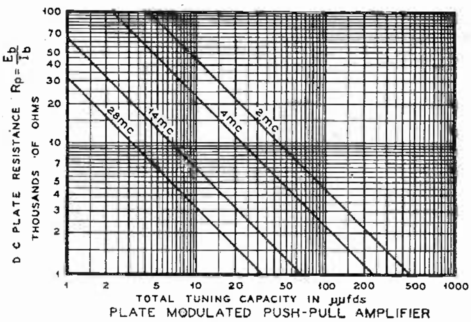


Fig. 1

to the Tuning Capacity Scale. In this example the proper tuning capacity would be 45$\mu\mu$f at 4-mc. and 90$\mu\mu$f at 2-mc. The total tuning capacity includes all tube capacities and the resultant series capacity of the two sections of a split-stator plate tuning condenser. The correct inductance for this capacity can then be calculated and designed for the desired frequency.

Capacities for Grid-Modulated Amplifiers

FIG. 2 gives values for grid modulated push-pull r-f amplifiers, and is used in the same manner as that described for a plate-modulated r-f amplifier. The grid-modulated amplifier operates at a much lower plate circuit efficiency, with the result that the plate circuit impedance is much less.

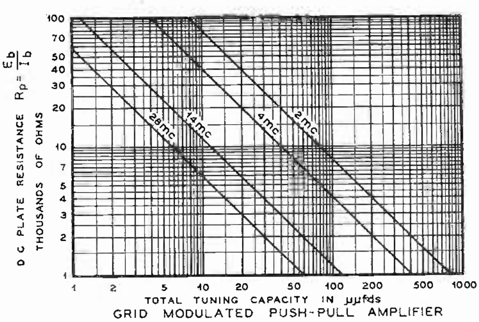


Fig. 2

The tuning capacities required are nearly twice as great as for plate-modulated amplifiers. If the efficiency of the grid-modulated amplifier be assumed to be 30 per cent, and the plate current flows for approximately 180° then, by following the same procedure as used for the plate-modulated case, we have

$I_{ac} = 1.57\, I_b$, $W_o = 0.3\, W_i = 0.3\, E_b I_b$, and

$$W_o = \frac{E_{LC} I_{ac}}{2} = \frac{E_{LC}(1.57\, I_b)}{2} = 0.785 E_{LC} I_b,$$

$$\text{whence } E_{LC} = \frac{0.3}{.785} E_b = 0.382E_b \text{ and}$$

$$Z = \frac{E_{LC}}{I_{ac}} = \frac{0.382E_b}{1.571_b} = 0.243\ R_p.$$

For a Q of 20 we thus have

$$C = \frac{Q}{\omega Z} = \frac{20}{0.243\omega Z} = \frac{13{,}100{,}000}{fR_p}\ \mu\mu f.$$

As in the case of a plate-neutralized amplifier, the tuning capacity will be one-fourth as great for a plate-neutralized single-tube amplifier, and one-eighth as great for a push-pull amplifier. The formula for the push-pull amplifier is:

$$C = \frac{1{,}636{,}000}{fR_p}$$

The tuning capacity for a given plate voltage and plate current would be the same for a push-pull or single-tube plate-neutralized r-f amplifier providing the Q is the same in either case. Push-pull operation permits the use of a value of Q equal to 10 in this case. Since the grid-modulated amplifier has a longer period of plate current flow, it might be possible to operate the amplifier with a lower value of Q without excessive harmonic radiation. However, it is suggested that the values given in the chart be used as a basis of design.

Cathode-Modulated Amplifiers

FIG. 3 is suitable for calculating the proper value of tuning capacities for a push-pull cathode-modulated amplifier. It will be seen that the tuning capacities are a little greater than for a plate-modulated amplifier, since the a.c. impedance of a cathode-modulated amplifier is lower than that for a plate-modulated amplifier for a given value of R_p.

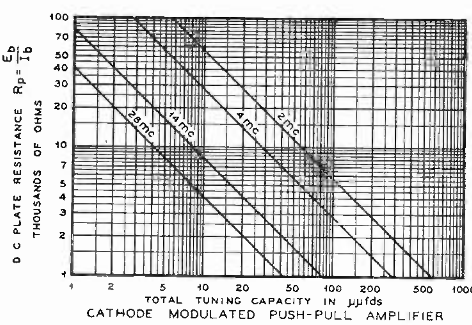


Fig. 3

The average cathode-modulated r-f amplifier can be assumed to operate at an efficiency of 50 per cent with a plate current flow of perhaps 150°. By following the procedure used in the preceding cases, the results are

$I_{ac} = 1.69\ I_b$, $W_o = 0.5\ W_i = 0.5\ E_b I_b$, and

$$W_o = \frac{E_{LC} I_{ac}}{2} = \frac{E_{LC}(1.69\ I_b)}{2} = 0.845\ E_{LC} I_b$$

$$\text{whence } E_{LC} = \frac{0.5}{.845} E_b = 0.59\ E_b \text{ and}$$

$$Z = \frac{E_{LC}}{I_{ac}} = \frac{0.59\ E_b}{1.69\ I_b} = 0.35\ R_p.$$

For a Q of 20 we thus have

$$C = \frac{Q}{\omega Z} = \frac{20}{.35\ R_p \omega} = \frac{9{,}100{,}000}{fR_p}\ \mu\mu f.$$

Likewise for a plate-neutralized r-f amplifier we have

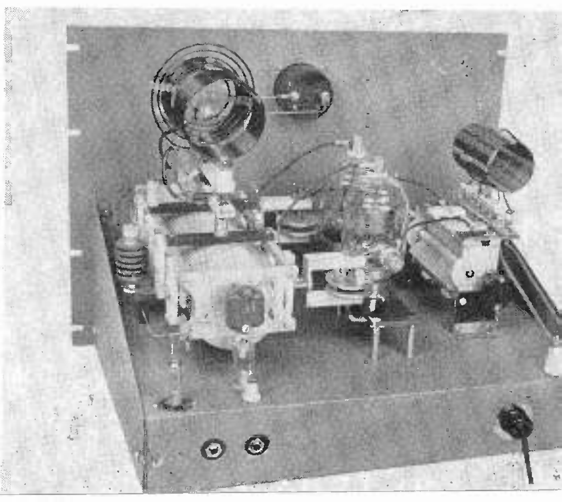
$$C = \frac{2{,}270{,}000}{fR_p}\ \mu\mu f$$

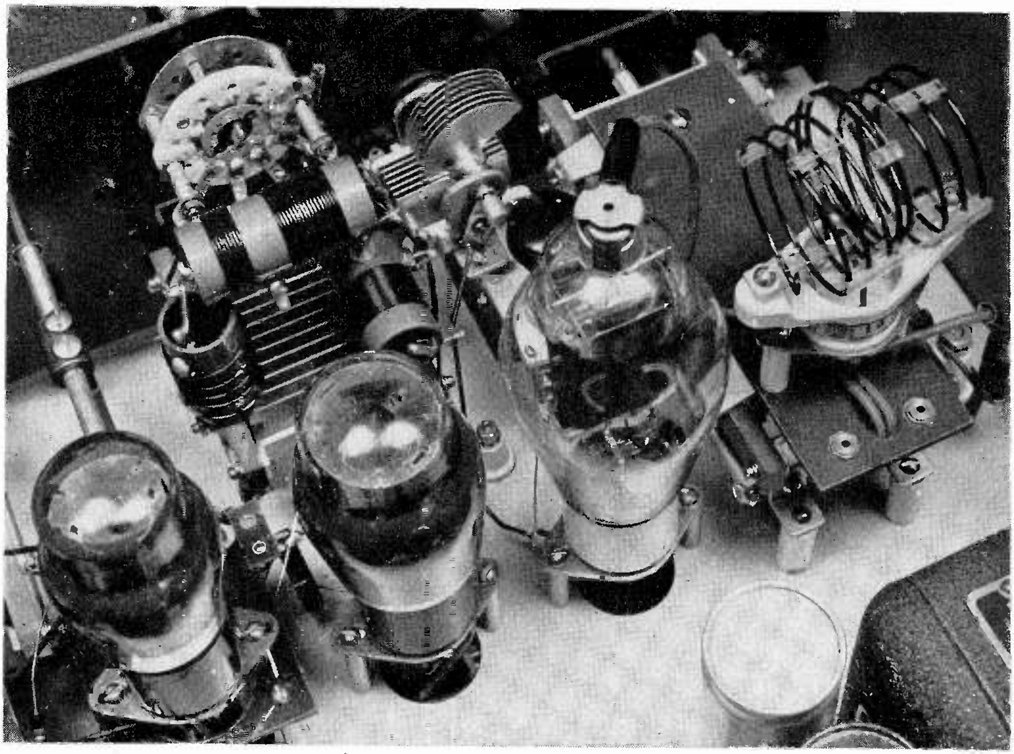
and for a push-pull cathode-modulated r-f amplifier

$$C = \frac{1{,}135{,}000}{fR_p}\ \mu\mu f.$$

From the preceding formulas it can be seen that a cathode-modulated amplifier should have approximately 25 per cent more tuning capacity for a given frequency and plate current, as compared with a plate-modulated amplifier. Since a plate-modulated amplifier is always operated at a higher value of d.c. plate current, the actual tuning capacity may be less in a transmitter

Push-Pull R-F Amplifier with Taylor TW-75 Triodes for Cathode Modulation. The inductance coil in the Plate Circuit is the New Bud Radio unit with Variable Spiral-Wound Antenna Coil.



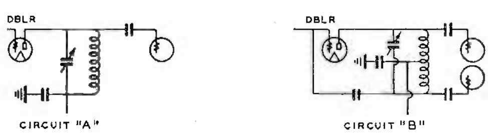


Home-Built Frequency Doubler Stage with Band-Switching and separate coil forms and windings to cover all bands from 20 to 160 meters. To the far right is another buffer.

designed around the same tubes for the two types of modulation.

Frequency Doublers

THE L-C plate circuit in a frequency doubler receives a surge of power every other cycle, as compared to every cycle in an r-f amplifier. For this reason, the circuit Q should be twice as high for a constant load resistance, such as an antenna. This means that the circuit Q should be approximately 25 for maximum power output on the second harmonic at unity power factor when the doubler is connected directly to an antenna.



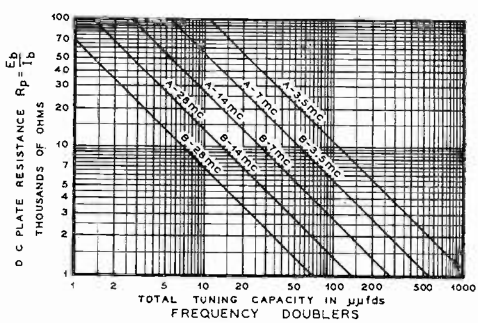
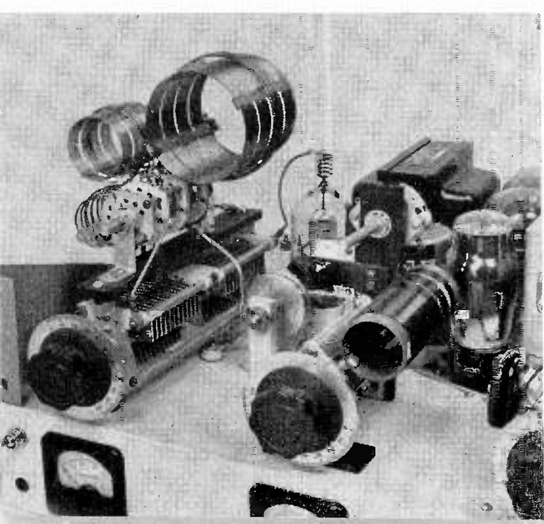


Fig. 4

In the more usual case of a doubler connected into a grid of a tube in a succeeding stage, the load resistance is connected across the doubler L-C circuit only during the time



of a.c. grid current flow, which is approximately one-fourth of each r-f cycle. This means that the Q can be one-fourth as great, or 6, and the L-C circuit will have sufficient fly-wheel effect to minimize the higher harmonics which may tend to reduce grid current.

For connection into a push-pull grid circuit, where each grid is driven on each half cycle, the Q should be made equal to 12. For a single-ended doubler plate circuit, where the tube is connected across the entire L-C circuit, the load impedance should be made equal to the a.c. impedance of the tube. Similarly, for a split-plate circuit the L-C load impedance should be four times the impedance of the tube, since the tube is connected across only one-half of the L-C circuit.

The same procedure as outlined in the preceding cases can be used to calculate the ratio of Z to Rp. Assume the doubler efficiency to be 40 per cent with a plate current flow of 90°:

$$I_{ac} = 1.9I_b,\ W_o = .40W_i = .4E_bI_b, \text{ and}$$

$$W_o = \frac{E_{LC}I_{ac}}{2} = \frac{E_{LC}(1.9I_b)}{2} = .85I_bE_{LC}$$

$$\therefore E_{LC} = .47E_b \text{ and } Z = \frac{E_{LC}}{I_{ac}} = \frac{.47E_b}{1.9I_b} = .248R_p$$

$$C = \frac{Q}{2\pi fZ} = \frac{Q}{1.56fR_p}$$

For a split-plate circuit $C = \dfrac{Q}{6.24fR_p}$, where C is in farads and f is in cycles.

The usual doubler stage with a triode tube is often used as a neutralized buffer, which means a split-plate circuit. For this case the formula becomes:

$$C = \frac{960{,}000}{fR_p}$$

when the doubler is working into a single grid circuit. The value of capacity should be multiplied by 2 for connection into push-pull grids. The capacity would be 4 times as great for the case of a screen-grid doubler tube, such as a 6L6, working into a single grid circuit, as shown in Circuit A of Fig. 4.

C.W. Push-Pull Amplifiers

A SEPARATE chart is given for a push-pull c.w. amplifier, since the desired frequencies of operation differ from those of a plate-modulated transmitter, and because a lower value of Q is permissible. The chart in Fig. 5 is for a circuit Q of 6, which is suitable for a push-pull c.w. amplifier.

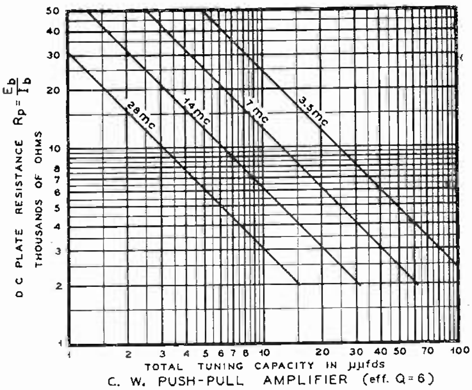


Fig. 5

This same chart can be used for a single-tube plate-neutralized r-f amplifier by multiplying the capacities listed by a factor of 2, since the circuit Q should be twice as high for a single-tube amplifier. The capacities listed in the chart can be multiplied by 8 for a grid-neutralized, or single screen grid tube amplifier having a circuit Q of 12. The plate resistance Rp in each case is the d.c. plate voltage divided by the desired value of d.c. plate current for the amplifier as a whole, whether it has one or two tubes. The plate current values are always the total values, whether the tubes are connected in parallel or in push-pull, or if only a single tube is utilized.

Parallel-Tuned Antenna Circuits

THE main purpose of a parallel-tuned antenna circuit is to suppress harmonic radiation, which means that the circuit Q should be at least 12. The additional parallel-tuned antenna circuit can be matched to a single-wire, two-wire, or concentric line feeder by taps on the coil, which, in turn, can be link-coupled to the tuned plate circuit of an r-f amplifier. Very little information has been available as to the proper design of such an antenna circuit.

In the formula: $C = \dfrac{Q}{2\pi fZ}$ any value of impedance may be chosen such as, for example, 5,000 ohms. This value of impedance will be suitable for connection to a 500- or 600-ohm line since the impedance transformation will be approximately 10-to-1. A very large impedance transformation, such as 100-to-1, will cause considerable power loss, due to the difficulty of obtaining an impedance match between the antenna feeder and the high-impedance tuned circuit.

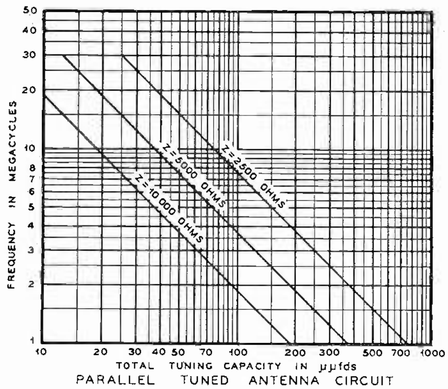


Fig. 6

In Fig. 6, three values of loaded tuned circuit impedance are given in the form of three curves plotted for frequency-in-megacycles-versus-tuning-capacity-in-$\mu\mu$f. A good average value for general use is the 5,000-ohm curve, in which case for a Q of 12,

$$C = \frac{382}{f}$$

If a lower value of C is desired, a higher value of loaded tuned circuit impedance will result, and more air-gap is needed in the tuning condenser. The effective voltage across the loaded tank circuit is equal to

$$\sqrt{W_0 2\pi fLQ}.$$

Where W_0 is the power supplied to the antenna circuit, f is the frequency, L is the inductance, Q is the desired value of circuit Q.

It can be seen from the above formula that the r-f voltage across the tuning condenser is proportional to the transmitter power output, to the frequency, to the value of inductance, and to the value of Q. If the antenna load is partially or wholly removed, the value of Q may increase 10 to 15 times and the peak voltage across the tuning condenser may be increased from 3 to 4 times. The above formula can be modified by substituting the expression:

$$\frac{1}{2\pi fC} = 2\pi fL$$

Doubling the inductance L, or halving the capacity C, will increase the r-f voltage 1.4 times, and will also double the loaded plate circuit.

In Fig. 6 the tuning condenser values chosen for a 2,500-ohm impedance would require four times as much capacity as for a 10,000-ohm L-C circuit, but only one-half as great an air-gap. A split-stator condenser connected in parallel would be used for the 2,500-ohm circuit, or connected with its two sections in series for the 10,000-ohm circuit. If the antenna feeders are connected across the correct number of turns in the antenna coil, the 600-ohm line can be matched to any of the tuned circuit impedances shown in Fig. 6. A low impedance circuit, such as a concentric line connected to a doublet or Marconi antenna should preferably be connected to a 2,500-ohm antenna circuit with a fairly high value of tuning capacity. In every case the amount of inductance is determined by the relation:

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Link-Coupled Grid Circuits

THE grid of a Class- amplifier acts as a load only during one-fourth or one-fifth of each r-f cycle and only during the peak portion of the driving power pulse. There is no need to supply a sine wave of voltage, since the useful part is that positive voltage which exceeds the negative d-c grid bias voltage. These pulses correspond to the periods of pulses of plate current in the buffer or doubler driver stage, whether it is linked to the grid circuit inductively or capacitively.

For this reason the tuned circuit needs no fly-wheel effect and its primary purpose is to build up as high an r-f voltage as possible across the grid or grids of the driver stage. A high L/C ratio is desirable, and the circuit Q can be as low as unity. When this was verified experimentally, a tuned grid circuit arranged for a circuit Q of 1 to 8 showed maximum driving power, for a given buffer stage input, when Q had a value between 1 and 4. For Q values of 7 and 8, less power was obtained.

In calculating the proper value of the tuning capacity, C, for a given Q, let us adopt the following simplified designations:

i = a-c peak grid current.
e = peak grid voltage.
Z = grid impedance.
W = grid power.
I = d-c grid current.
E = d-c grid voltage.
R = grid resistance.

We can then write

$$W = eI = \frac{ei}{2}, \text{ whence } i = 2\,I.$$

$$Z = \frac{e\text{-}E}{i} = \frac{e\text{-}E}{2\,I}$$

For most c.w. or plate-modulated Class-C amplifiers e has a value of from 1.5 to 2.5

times E. Assuming the average value to be e = 2 E, we can write

$$Z = \frac{2E - E}{2I} = 0.5 \frac{E}{I} = 0.5\ R.$$

For Q = 1, we finally have

$$C = \frac{Q}{\omega Z} = \frac{1}{\pi f Z} = \frac{318{,}000}{fR}\ \mu\mu f.$$

where f is the frequency in megacycles and $R = \frac{E}{I}$ and is the grid resistance in ohms.

For the various amateur bands the calculated values of the total tuning capacities are as follows:

Wavelength in meters:	160	80	40	20	10
Capacity in $\mu\mu$f:	32	16	8	4	2

Some of these values are less than the stray circuit and tube capacities. Since the Q can be greater than unity without causing a drop in grid driving power, but must be less than 6, the same capacity values are suitable for push-pull grid circuits. The general rule for obtaining maximum grid drive in a link-coupled system is to make the L/C ratio as great as possible for resonance at the desired frequency.

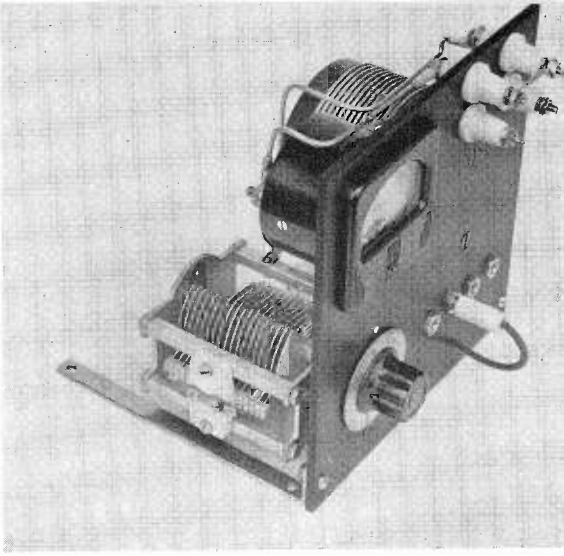
Condenser Air-Gap Notes

A FORMULA has been given in the preceding discussion for calculating the effective voltage across the tank circuit. The peak voltage is 1.4 times this value. The values of peak r-f voltage which will be encountered in the different types of circuits discussed previously, is given by the relation of E_{LC} to E_b.

The peak value of plate voltage across that part of the tuned plate circuit which is shunted by the doubler tube, for example, seldom exceeds 0.47 × dc. plate voltage. If the doubler plate circuit is split with a split-stator tuning condenser, each section should have an air-gap capable of withstanding this peak r-f voltage. In practice a factor of safety of from 2 to 3 times the actual peak flash for breakdown rating should be used when selecting the condenser air-gap in order to guard against flashover during tuning adjustments.

For a plate-modulated or cathode-modulated r-f amplifier the peak r-f voltage will be increased in proportion to the amount of peak audio voltage supplied in the cathode or plate circuits.

For plate modulation this means that the peak r-f voltage will be twice as high at 100 per cent modulation as at zero modulation. In a cathode-modulated amplifier the peak audio voltage is usually from one-fourth to one-half as great as that required for plate modulation, and the peak r-f voltage is correspondingly less. Since the peak r-f voltage is also a small proportion of the d.c. plate voltage, the air-gap for a cathode-modulated transmitter operating at a given value of d.c. plate voltage may be reduced as much as 50 per cent as compared to a plate-modulated amplifier. The values of circuit impedance and a.c. voltages and currents expressed in terms of ratios to the d.c. values are often useful in designing an r-f amplifier for any type of service. These values were shown under each respective sub-heading in this text.



Versatile Antenna Coupling Unit for Series or Parallel Tuning. Note Plugs and Jack for Selecting Various Values of Inductance.

Conference on Frequencies for Electro-Medical Apparatus

RECOGNIZING the importance of electro-medical apparatus to the medical profession in the treatment of human ills, the Federal Communications Commission has scheduled an informal engineering conference at its Washington offices on November 29, starting at 10 a.m., to facilitate establishing particular frequencies for the exclusive use of such equipment and promulgation of engineering standards to further promote these devices with mutual solution of interference questions.

It is through the cooperation of interested individuals and groups that the Commission hopes to adjust the technical problems in connection with operation of high frequency electro-medical equipment. Such effort is in keeping with views expressed at the Inter-American Radio Communications Arrangement signed at Santiago, Chile, last January.

A Practical Approach To The V. F. Oscillator Problem

Stability and reliability are vital considerations in the design of an Electron-Coupled Oscillator. Clickless keying is also of paramount importance. Here is a comprehensive treatise on a timely subject—one which every amateur should study with care. It incorporates many innovations.

*By Clayton F. Bane**

ONE can hardly find a more controversial subject than the variable frequency, ECO, call-it-what-you-will oscillator. It appears that there are almost as many different versions as there are men who use them. With this thought in mind, the material that follows is not propounded as the ultimate, although it offers some ideas which have not been treated by other workers. None of this material has been hastily conceived; on the contrary, it is the result of several months of experimentation and is submitted with the assurance that it is eminently practical in every respect.

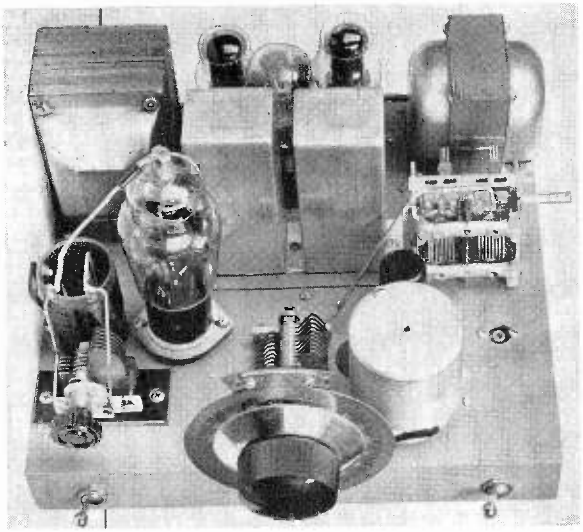
For spot-frequency work, nothing has yet been devised that will improve upon a good, low temperature coefficient quartz crystal. The user at all times has the assurance that the transmitter is on the frequency of the crystal, within narrow limits. When the crystal is replaced by some type of self-controlled oscillator, however, this assurance vanishes. Not only does the oscillator have to be set on the desired frequency as determined by known standards of calibration, but the further problem arises that the oscillator may not remain where it is set. This entails the two most important considerations from the standpoint of the amateur, (1) calibration, and (2) frequency stability.

Calibration is most easily accomplished by placing the frequency of the oscillator at a point in the spectrum where known calibrations are readily obtainable. Generally speaking, this requirement is fulfilled only in the broadcast band, and by *WWV*, the U. S. Bureau of Standards station operating on 5,000 kc. If the frequency-controlling circuits of the oscillator are placed so as to cover a portion of the standard broadcast band including the fifth submultiple of 5,000 kc. (1,000 kc.), highly accurate calibration points are instantly available. This calibrating feature then sets the grid circuit of the oscillator in the broadcast band, and the next important factor, frequency stability, must now be considered.

True of a crystal, equally true of a **VF** oscillator, the higher the order of frequency multiplication from the oscillator to the ultimate output frequency, the greater the frequency drift. It can be readily seen that in placing the oscillator at a very low frequency for convenience of calibration, the drift factor is automatically increased. Example: oscillator on 1,000 kc., output frequency of transmitter, 14,000. This is a multiplication of 14 times. Thus if the oscillator drifts 10 cycles, the shift is 14 x 10, or 140 cycles on the output frequency. This is not quite as serious as it appears, since a good **VF** oscillator can actually be made a great deal more stable than many high-drift "bootleg" crystals in common amateur use. Consideration, however, must be given to ways and means of achieving stability.

The selection of a proper tube for the VF oscillator is of primary importance. It has been well established by other workers, and verified by the writer, that the 6SK7 tube is well suited to the application. Primary consideration for this selection is the fact that this tube is well screened. It has excellent isolation between grid, frequency-control element, and the plate. This is highly important, since it is essential to have all possible isolation of the grid circuit to prevent feedback and interaction from the final amplifier and buffer stages. Tubes of the power type, such as 6L6, 6V6 and 6F6, are capable of delivering greater output power, but the screening is so inferior that interaction is

*Chief Engineer, Technical Radio, Inc.



To the right is the first experimental model, built upon a heavy aluminum chassis. Conventional receiver-type components were used throughout, except for the shield can around the oscillator coil; this can is of heavy cast aluminum. The power supply is also mounted on the chassis, and no difficulty was experienced from vibration because of the rigid construction.

inevitable. Interaction, translated into practical terms, means simply that every time the final amplifier is tuned, the oscillator frequency will change. Extreme care in layout and careful shielding will largely eliminate "pulling" effects.

Again considering power-type tubes, it is inconsistent to expect an oscillator with high frequency stability to give large power output. The two considerations do not go together. Full advantage must be taken of the screening of the oscillator tube with the hope of approaching the ultimate, wherein the plate circuit has pure electronic coupling and a very minimum of "pull" on the grid circuit. The tube itself, and proper mechanical placement of parts, will do all that is possible in this regard. The problem of frequency drift is not so easy of correction.

Since the grid-to-cathode capacitance of the tube is unalterably across the tuned, frequency-controlling circuit, a change in this capacitance will cause a corresponding change in frequency. The variation of tube capacitance is due to an actual physical change in the elements as the tube heats up. This in itself is a fixed condition, and nothing can be done about it. It is possible, however, to so arrange the C to L ratio of the associated tank circuit that it will be extremely large in proportion to the element-capacity change. For example, if the tank is tuned to a frequency of 1,000 kc. with 100 micro-microfarads, and if the capacitance of the tube, while heating, changed 5 micro-microfarads, the tube change would be 5-in-100, or 20 per cent total capacity change across the inductance. If the tank tuning capacity is increased to 500$\mu\mu$f (inductance decreased to maintain frequency at 1,000 kc.) and the tube change remains at 5$\mu\mu$f, the total change is 5-in-500, or 1 per cent. While such a procedure is practical, it introduces additional objections, some of which are as undesirable as the original. When high C to L ratios are used, the RF circulating currents within the parallel tuned circuit increase proportionately, with the result that if extreme care is not exercised in designing the inductance, its characteristics will change with heating. Drift will then be an inevitable consequence. Augmenting this latter condition, the fact remains that large variable condensers must have a large number of plates and dielectric spaces. A slight mechanical vibration is apt to cause a relatively great capacity change, resulting in greater shift. This problem can be solved by applying another approach suggested in the excellent treatise by *Lampkin.**

When the grid is tapped down on the coil, the effect of the grid-cathode capacitance change is greatly minimized. Without going into a theoretical treatment of the full explanation, let it suffice to say that as a given condenser is tapped down on an inductance so as to appear across only part of the total turns, the net frequency change is less than if the same condenser were across the entire coil. Substituting the grid-cathode capacitance in the previous analogy, the farther down the grid is tapped, the less will be the effect of the tube capacity change on the frequency. This offers a means of minimizing

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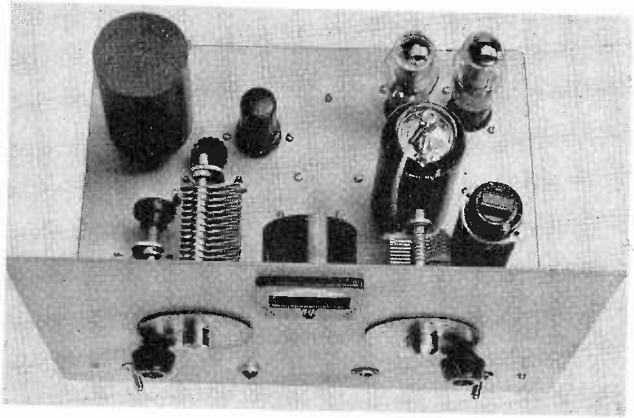


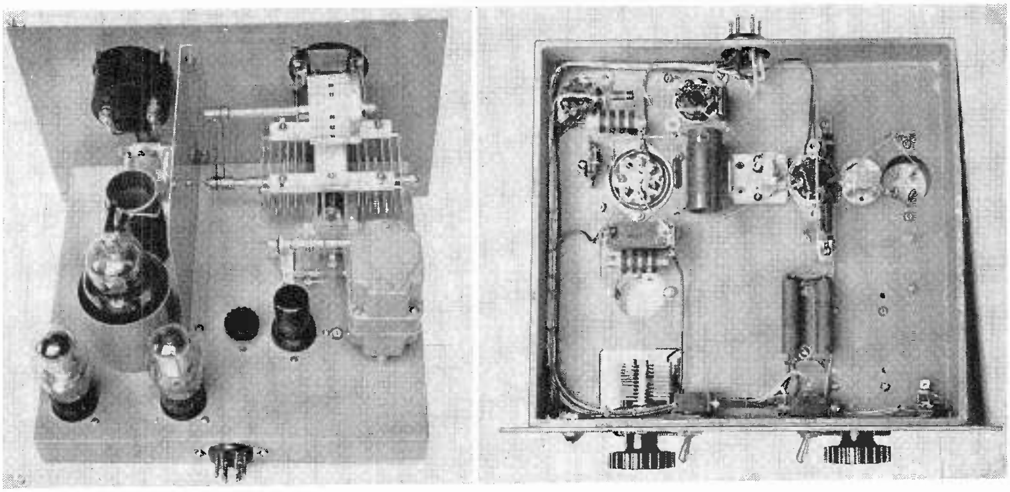
Another experimental model was built by W6SEM before the final design was constructed. This model is shown to the left. Like the first model, an aluminum chasis was chosen, and the components are again of the conventional receiver-type. A heavy aluminum can was likewise placed over the oscillator coil. Results were entirely satisfactory.

the effect of the tube without the need for great increases in the C to L ratio of the tuned circuit. However, the problem of developing *some* power from the oscillator is of primary concern, since it is to be used to drive another stage, and not operate merely as a frequency meter. The grid circuit of the tube must then work into a reasonable impedance in order to deliver this power. Since, as the grid is tapped down, the impedance is likewise stepped down, a compromise point must be chosen. This means that it will be necessary to use a slightly higher C to L ratio in the tank than would be required if power output were not a consideration. In the particular units described in this text this additional shunt capacity did not exceed 150$\mu\mu$f, which is entirely practical from every standpoint. It was determined that the grid could be tapped approximately one-third of the total turns down from the top of the coil. *Lampkin*, who was primarily concerned with frequency measuring equipment, used ratios of tap-to-total-turns as low as 0.5.

Changes in the inductance of the L/C circuit due to temperature variation can contribute greatly to the total frequency drift, and numerous ideas have been suggested and used for compensating these changes. Since most of them lie beyond the scope of the average amateur, further discussion will not be undertaken, because there is a simple, logical answer: *temperature-insulate the coil.* Remembering that heat and cold are applied to the coil by conduction, reasoning will show that as the air in the cabinet becomes heated, the coil will soon become warm. If this coil is totally enclosed in a thick-walled metallic shield with ample air space between the inner walls of the shield and the outer walls of the coil form, excellent results will be obtained. It will be found that only extreme changes in temperature will affect the coil. Different mechanical versions of temperature shields were tried, all of which yielded excellent results. Two models used a carefully machined dural tube with a ⅛-inch wall and snug-fitting top and bottom. One shield was lined with asbestos. For a final version, consideration was given to an effective shield which could be assembled from standard parts. The die-cast cups manufactured by *James Millen* were used in the final model. While not possessing the maximum thickness desired, they nevertheless make up into a very effective unit. The round ceramic base with standard four-prong pins (made by the same manufacturer, to fit the opening in the shields) was used as the mounting medium for the coil. Close observation of the photograph will illustrate how the coil is supported. Four lengths of No. 14 tinned bus wire are first run up through the base pins and soldered into position. These four leads, extending into the shield, are used as a firm anchor for the lugs of the coil. The bottom leads are bent into position so as to make connection with the grid condenser, cathode, tuning condenser and ground, as can be seen in the bottom-view photograph.

In the school of thought which maintains that the best temperature compensation is none at all, no mica condensers are used in the grid circuit of the oscillator. In place of the conventional mica condenser normally used to block the grid from the L/C circuit, a midget air trimmer is used. In this system there are no worries about positive and negative coefficients of drift—all of the condensers have the same dielectric—air.

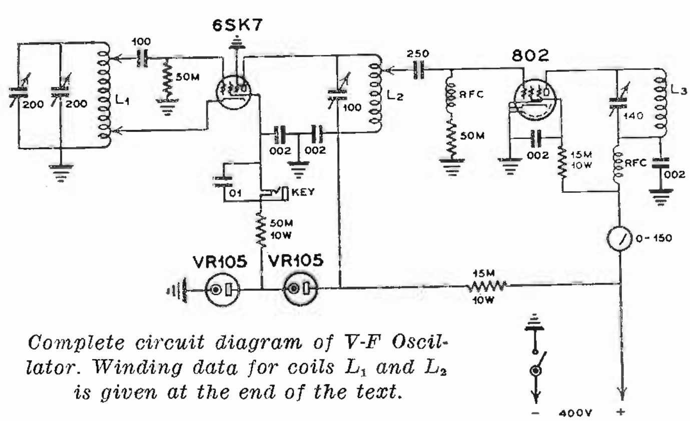
If the final version of the VF oscillator resembles a high-power final amplifier, as some may suggest, bear in mind that just *any* condenser will *not* suffice. The main



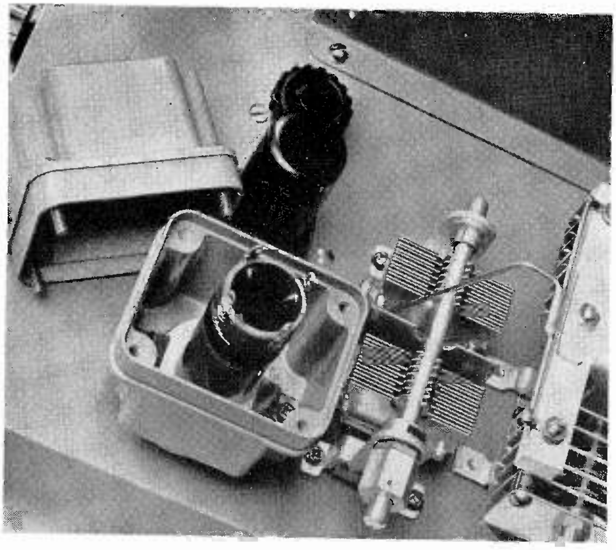
Top and bottom views of the final model, an approach to perfection, and in which no compromise was made. The chassis is of cast aluminum, the shield around the oscillator coil is the new James Millen product. The tuning condensers are by the same manufacturer, as is the drum dial assembly. These sturdy components play a major part in the overall performance of the unit. Results were superb.

tuning condenser, in particular, must be solidly built, should have thick plates and wide spacing. The latter feature will minimize the effect of vibration on capacity change. The final model illustrated uses *James Millen* condensers. Two other models are also shown, which used different components throughout. This model works, and does a good job, but the final model, taking minute details into consideration, performs a bit better—a step closer to the ultimate.

It is not enough to merely have all the mechanical rigidity in the tuning condensers, since these advantages can be immediately nullified by a flimsy chassis. This is one component which remained intact in all of the three models illustrated. It is of cast aluminum, approximately ¼-inch in thickness, 9½ x 10⅝ x 1½ inches. Such chassis are not expensive, although they are not readily obtainable on the open market. The builder has the alternative of using an 18-gauge steel chassis with open top, and then bolting a plate of dural, ⅛-inch or 8-gauge, to the top, on which all components are mounted. Why such a heavy chassis? One can strike the cast aluminum chassis a sharp blow with a machinist's hammer without affecting the oscillator frequency. Such treatment of a light steel chassis gives opportunity for speculation. Do not overlook the panel, since it can cause as much trouble



Complete circuit diagram of V-F Oscillator. Winding data for coils L_1 and L_2 is given at the end of the text.



Looking into the Millen shield can which houses the layer-wound oscillator coil. This coil is wound in three layers, with taps taken according to the data given at the end of the text. The Millen padder condenser is mounted directly alongside the oscillator coil shield. Once adjusted, it is held in position by means of the lock-nut assembly. A small portion of the main tuning condenser is seen at the extreme right.

as the chassis, particularly if the oscillator tuning condenser is in close proximity. Use at least ⅛-inch stock, steel or dural, and brace it well. All of these factors contribute to the final result and are "musts." All can be wasted, however, if extreme care is not taken with the wiring.

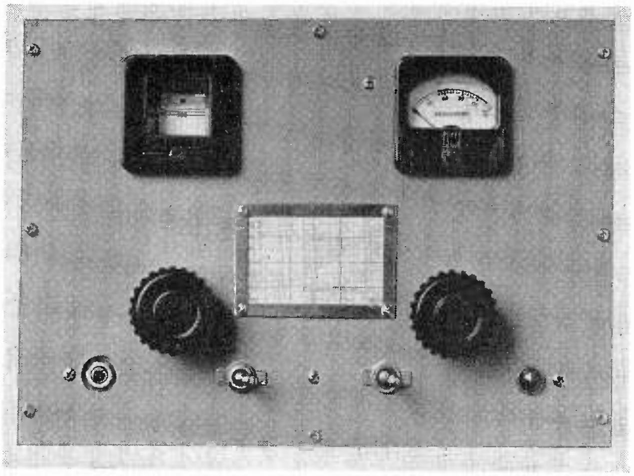
No attempt has been made to produce a beautiful wiring job, but rather to wire as short and direct as possible. All r-f circuits are wired with No. 14 tinned copper bus, and too much stress cannot be laid upon the necessity for making stiff, short runs. All this wiring has a definite capacity to ground (chassis), and this capacity must remain constant under all conditions. Speaking generally, any bus-bar over 2 inches in length should have an additional support in the form of a tie-point or stud. The under-chassis view will illustrate the point.

The oscillator main tuning dial is important if the unit is to be used for frequency measuring where reliance on the calibration is to be made. The final model used a new *Millen* drum dial, since it offered possibilities for front panel symmetry. This necessitated a string drive from the condenser, which can be a nuisance if the job is not properly done.

All possible isolation of the oscillator must be the goal if "pulling" by the buffer is to be avoided. As has been stated, the plate circuit of the oscillator itself must be completely shielded from its grid circuit, in order that pure electron-coupling obtains; consequently a shield is used on the bottom of the 6SK7 tube socket. This is plainly visible in the photographs. The 802 buffer was selected over a number of other tubes, since its screening proved much better. With reasonable care, no oscillation troubles will be experienced. Oscillation or regeneration in this stage cannot be tolerated, owing to the severe interaction on the oscillator when such a condition exists. In one of the models it was found necessary to completely remove the 802 plate circuit choke to prevent self-oscillation.

The 802 buffer is capable of furnishing approximately five to eight watts output on either the 160 or 80 meter bands. When operating on 80 meters it is called upon to double, which it does with reasonable efficiency. The plate circuit of this stage is designed to cover both bands on a single condenser. To accomplish this, the distributed shunt capacities, as well as the oscillator inductance, must be of the correct values. Reference is made to the article on shunt capacities elsewhere in these pages as a means of clarifying this and other points pertaining to the L/C circuits.

It would appear to be common practice to use a resistance-coupled buffer stage from the VF oscillator as a means of isolation; this is a disadvantage, in that the power output is very limited. The plate circuit of the oscillator is actually tuned with an L/C circuit. This is done to increase the power output, since the oscillator doubles in its plate circuit. With resistance coupling under these conditions, the output would be almost negligible. Additional isolation is achieved by doubling, grid and plate circuits being then on different frequencies. In order to make this point thoroughly clear, the oscillator grid circuit is on the broadcast band, and the oscillator plate circuit is on the



Symmetrical, professional appearance is given the front panel by choice of modern components. The dial window assembly is manufactured by James Millen Co., the meter by Simpson. A calibration chart lends further beauty to the front assembly, not to mention its importance and convenience. The keying jack is at the far left.

160-meter band. This condition obtains at all times, since the lowest possible amateur band is 160 meters. The actual frequency of the grid circuit will vary, but it will normally lie within the range of 900 to 1,050 kc.

The plate circuit of the oscillator, while tunable, is actually tuned once only, with the grid circuit of the oscillator set to give a harmonic approximately in the center of the bands most commonly used. In covering the entire range of from 3,500 to 4,000 kc., the single tuning of the plate circuit to 3,800 kc. gives excellent output on both ends. This tuning control is inside the cabinet and normally does not have to be readjusted. A word of caution: unless extreme care is taken in shielding and circuit isolation, there will be some "pulling" of the frequency as the plate circuit is tuned through resonance. This is tolerated, since it has no further bearing once it has been initially set.

The buffer circuit is entirely conventional in its tuning and operation. Once the oscillator plate tank has been resonated as previously described, the buffer may be tuned to resonance by the normal dip in plate current. Coupling from the buffer to the next stage of the transmitter may be either by link or capacity coupling. When using the latter method it will be necessary to tap down on the buffer tank. In addition, the capacity of the next grid circuit will be effectively across the buffer tank, and unless this grid is tapped down, the shunt capacity may be sufficient to change the tuning range of the buffer L/C tank circuit. Practically, this means that it may then be impossible to cover both 80 and 160 meters on the one coil and tuning condenser. Judicious use of link coupling should obviate this difficulty.

In making the initial set-up of the oscillator, an all-wave receiver must be used for establishing the preliminary setting of the parallel capacity across the main oscillator tuning condenser. In addition to the broadcast band, the signals of *WWV* on 5,000 kc. will help immensely, these being used to identify the 1,000 kc. point. It is only when first setting-up that extreme care must be taken, since with the large shunt capacity in the oscillator grid circuit it is possible to cover quite a range of frequencies in the broadcast band. However, unless your oscillator is tuned within the range of 900 to 1,050 kc., the harmonics will not lie in proper relation to the amateur bands. First find the 1,000 kc. point on the receiver dial. This can be initially checked on the fifth harmonic (*WWV*, 5,000 kc.), and then checked back to 4,000, 3,000, 2,000 and finally to 1,000 kc. It is entirely possible to be on a number of frequencies other than 1,000 kc. and still produce a beat with *WWV*. Example: the sixth harmonic of 833.3 kc., the seventh harmonic of 714.2, the eighth harmonic of 625, the ninth harmonic of 555.55. Thus it can be seen that for the true 1,000 kc. fundamental, harmonics must appear at even 1,000 kc. harmonic points. Having definitely identified this point, it is simple to move the oscillator tuning condenser to a lower value and find some broadcast station near the 900 kc. point against which a definite calibration point can be taken. As the shunt-pad condenser is *increased* in capacity, the main tuning will *decrease* in order to maintain resonance with a given fixed station. Select as the final operating point a position of the shunt-pad condenser which will utilize as much of this capacity as possible, yet still be able to cover the 1,050 to 900 kc. range on the main tuning condenser.

As a quick rule of thumb, it is best to set the main tuning condenser close to *minimum* capacity, and then identify the 1,000 kc. point with the shunt-pad condenser.

Little has been said about the power supply, or the need for voltage regulation. The power supply can be conventional, the only requirements being reasonable regulation, good filtering, and approximately 400 volts DC output at 75- to 100-ma. The voltage regulators are included in the oscillator unit and are highly important, in that they provide a stabilized voltage for both plate and screen of the oscillator. With the series resistor and 400-volt supply, the two VR-105 tubes operate so as to give excellent regulation characteristics. The oscillator screen operates at very low voltage, since it is further dropped from the tap between the VR tubes.

For CW operation, the oscillator can be very successfully keyed without the slightest sign of a chirp. Keying is done in the screen, and the key should be by-passed with approximately .01μf to avoid a slight click from the key. If desired, a small cathode resistor can be inserted in the cathode lead of the 802 to hold its plate current down when the oscillator screen is opened and the excitation stopped. Cathode bias on succeeding stages is also effective.

In conclusion, it should be stated that all phases of these units were thoroughly checked for a considerable period. The original unit is also illustrated, since it has a power supply included, also a different type of dial. This unit gave excellent results. The second unit was built by N. R. Farbman, W6SEM, from information furnished by this text. Note that this unit departs entirely from the other two versions. In all three units, however, the basic idea of temperature-insulation has been applied, and in all cases has proved its worth. If one final comment might be made, it could be simply stated that it is hopeless to attempt to duplicate these results unless all of the principles advocated are applied. One omission, and the careful work may be for naught. Here is a case where a number of small details combine to produce a final satisfactory result.

The writer expresses appreciation for ideas and suggestions secured from the excellent writings of *Lampkin*, *Perrine*, and other workers, and hopes that this article may serve to fill in a few of the remaining stopgaps toward realization of the ultimate in VF oscillators.

Coil Data

L_1—Form ⅞-in. outside diameter, natural bakelite, 2½-in. long. Actual winding occupies only ⅝-in., starting ¼-in. from top of form. Wire used is No. 28 BS gauge-D.S.C. copper. The winding is in three layers, 75 turns total, with a tap taken on the 25th turn for the grid, another tap taken on the 56th turn for the cathode.

L_2—Form ⅞-in. outside diameter, natural bakelite, 2½-in. long. Wound with 90 turns of No. 28 B.S. gauge-D.S.C., and tapped 25 turns down from the plate end.

L_3—Form 1½ in. outside diameter, natural bakelite, 3¼-in. long; 49 turns No. 20 enameled wire. Winding length, 1⅞-in.

Oscillator Coil Shields—Millen Mfg. Co., Inc.

Dial and Variable Condensers—Millen Mfg. Co., Inc., condensers as follows: Cat. No. 13050, 10001.

Meter—Simpson 0-150 MA. Midget Square Case.

Sockets and Power Plug—Amphenol.

Switches—H. & H.

Caution in Handling Philippine Traffic

IT has recently been called to our attention that message traffic destined for the Philippine Islands has been returned as undeliverable because the text pertains to business transactions. In the continental United States it is permissible for amateurs to handle traffic of any kind, provided no compensation, directly or indirectly, is received; Philippine stations, however, are forbidden to handle messages of any but a personal nature.

Section 22 of the Order Issued by the Department of Public Works, Manila, P. I., reads as follows:

Communication between the Philippines and the United States: Philippine Amateur Stations communicating with the United States may transmit or receive plain language messages or remarks of a private, personal or social nature, including those emanating from third parties—provided that no hire or material compensation, direct or indirect, paid or promised, is involved or received. *Under no circumstances shall a Philippine amateur station owner or operator transmit, receive, or deliver a commercial or business message.* As a general rule, a "Commercial" or "Business" message shall be understood to be that which relates to the business of any person, firm, corporation, association, or organization.

Amateurs are also cautioned to refrain from handling messages in any language other than English, even though the practice is lawful.

An Inexpensive Portable Antenna

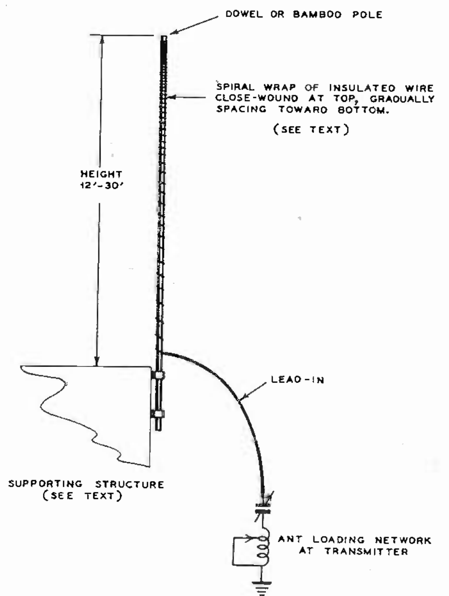
This antenna merits more than a casual glance by those interested in portable equipment operating at the lower frequencies. Originally developed for commercial and pleasure yacht applications, it has given excellent results with low-power equipment and is readily adaptable for amateur work. Extensive tests have shown it to be superior to the whip-type, or other short verticals of equivalent length, for low-frequency operation.

*By. W. J. Stancil**

DUE to the great amount of publicity accorded the ultra-high frequencies, many who contact our organization for radio communication systems expect us to sell them a little box with a couple of tubes and a 12-inch antenna capable of solving all their problems. We must then explain the phenomena experienced throughout the frequencies available from 2- to 300-megacycles, or higher. Usually for the application in mind, the frequencies from 2- to 4-megacycles are the most dependable, day and night, and offer a range of a hundred miles or more with five or ten watts output to the antenna. Up to this point, the prospect is quite happy about the situation, and then comes the subject of an appropriate antenna. Rather than have a victim of heart failure on our hands, we don't even mention the length of a half-wave antenna, but merely suggest that we might use a quarter-wave, sixty or more feet in length, depending, of course, upon the proposed frequency of operation. Owners of boats, in particular, with their twenty-five foot hulls don't appreciate our ideals, and thus it became necessary for us to devise a fairly efficient system, not too unsightly or bulky.

The transmitters as supplied from the factory have a continuously variable loading system to match from twenty to ninety feet of wire, and obviously this system utilizes an inductive-capacitive network to compensate for the difference between a quarter-wave antenna and the length available. The current loop or anti-node in a quarter-wave antenna is right at the transmitter and ground connection, and since we are vitally interested in this current we attempt to transfer as much of it as possible along the radiating system, where it will do more good than merely cause a bright glow to emanate from the current indicating device. If this inductance could be removed

*7977 *Santa Monica Boulevard, Hollywood, California.*



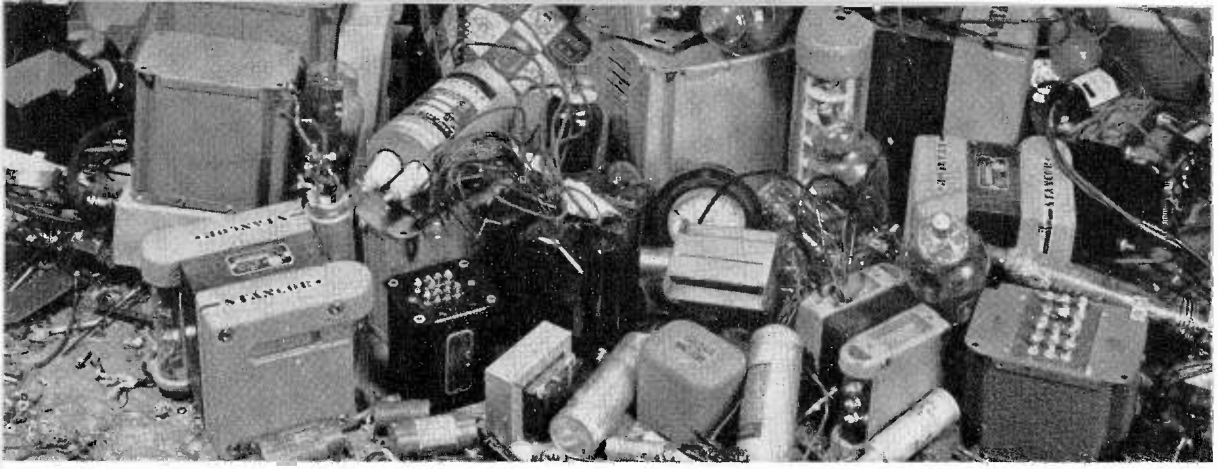
Constructional Details for Portable Antenna.

from the loading system and nailed to the masthead, we could move some of the current toward the top of the antenna. However, since most of our activity is in the portable or portable-mobile field, the use of inductances or large capacitive areas is impractical.

An eastern manufacturer, during a recent demonstration of boat antennas, wound a quantity of wire in the form of a loose spiral around a bamboo pole supported by insulated guys, using the guys and the spiral for the radiator. This antenna seemed to work very well, although the guys did not increase the field strength sufficiently to warrant the extra wires required. Perhaps the relatively sharp angle of the guys presented a slight amount of interference, or possibly cancellation.

Our own experience proved that 25-foot

(Continued on page 51)



Filter Design Calculator

Quickly Finds L and C Values for Any Load and Cut-Off Frequency; Based Upon Proved Engineering How and Why

By Arthur H. Halloran

AN ELECTRIC filter consists of a combination of condensers and inductance coils in a circuit designed either to pass or to by-pass a specified band of frequencies in the current supply to a given load. It is known as a low-pass filter when it passes a band of frequencies between zero and f_c, the cut-off frequency, and by-passes frequencies higher than f_c. It is known as a high-pass filter when it passes all frequencies higher than f_c and by-passes all frequencies lower than f_c. The cut-off is not absolute, or sharply defined, in a single section of a filter, but can be closely approximated by employing several sections.

Two types of low-pass and high-pass filters are in general use. Because of their general shape, these are known as T-types and π-types, respectively. The two types for both low- and high-pass filters are shown at the top of Fig. 1. Here it may be noted that the high-pass filters of both types have condensers in series with the load, *R*, and inductances in parallel, thus passing the high frequencies to the load and by-passing the low frequencies. Conversely, the low-pass filters have inductances in series, thus passing the low frequencies, and condensers in parallel, thus by-passing the high frequencies, in the current supply to the load.

The fundamental specification for both design and performance is that the internal impedance of a section without load be equal to the impedance of the load. This is in accordance with the well-known fact that any electrical device operates most efficiently when the impedance of the external load matches the internal impedance of the source of power. Furthermore, the best performance is provided by a resistive load, R, which absorbs real power rather than by a reactive load which alternatively stores and restores wattless power.

The correct values of inductances and capacitances for low-pass and high-pass filters of either the T- or the π-type can be mechanically found by means of the chart on the facing page, at the bottom of which are printed the directions for use. The chart is seen to consist of three sets of double scales. That on the left is a scale of cut-off frequencies for both low- and high-pass sections. That on the right gives load resistances in ohms, the left-side scale being used for figuring inductances and the right-side scale for figuring capacitances. That in the center gives inductance values on the left side and capacitance values on the right side. The L and C values thus obtained are to be used as the values in the circuit diagrams for the several sections shown at the top of the chart. The manner of use can easily be learned by following through several typical examples.

Power Supply Filter

WHAT are the proper values of L and C in a filter for smoothing the ripple in the rectified 60-cycle single phase current supply to a 3,000-ohm load, assuming it to be known that 120 cycles is the lowest frequency in the output from such a filter?

The first step is to select the desired cut-off frequency, making due allowance for the fact that the cut-off is not sharp. From

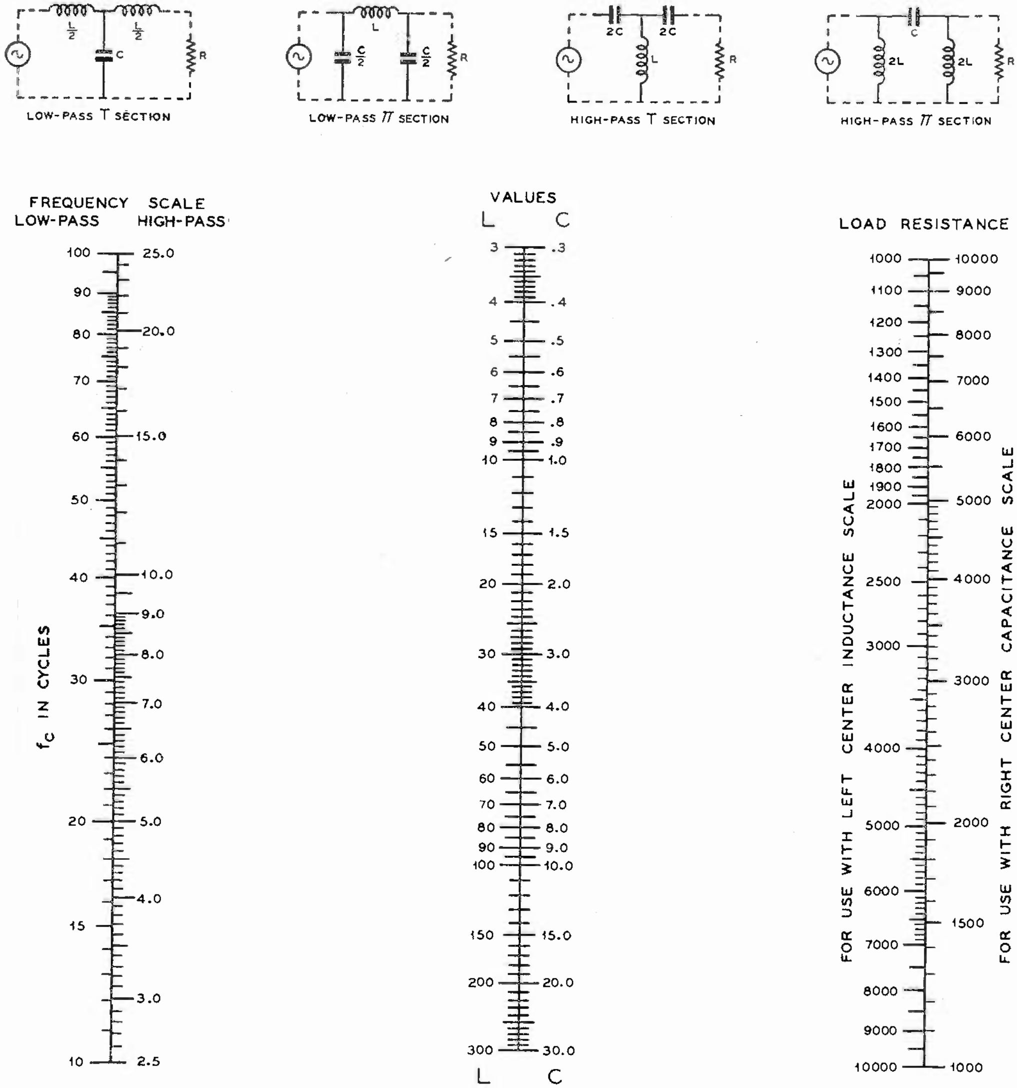


Fig. 1—Filter Design Calculator Chart for π- and T-type Sections.

To find L, connect cut-off frequency on left-hand scale (using left-side scale for low-pass and right-scale for high-pass) with load on left-side of right-hand scale by means of a straight-edge, and read value of inductance where edge intersects left-side of center scale. Readings are in henries for frequencies in cycles per second.

To find C, connect cut-off frequency on left-hand scale (using left-side scale for low-pass and right-side scale for high-pass) with load on right-side of right-hand scale, and read value of capacitance where straight-edge cuts right-side of center scale. Readings are in microfarads for frequency in cycles per second.

For each tenfold increase in frequency divide L and C values by 10, thus giving direct readings of L in millihenries and C in thousandths of a microfarad for frequencies in kilocycles, and of L in microhenries and C in micro-microfarads for frequencies in megacycles.

For each tenfold increase in load, multiply L by 10 and divide C by 10. For each tenfold decrease in load divide L by 10 and multiply C by 10.

the performance curves, to be explained later, it can be seen that a 40-cycle cut-off will eliminate a goodly part of the 120 cycle and higher frequency components. So let us provisionally select 40 cycles as the desired cut-off for a low-pass filter.

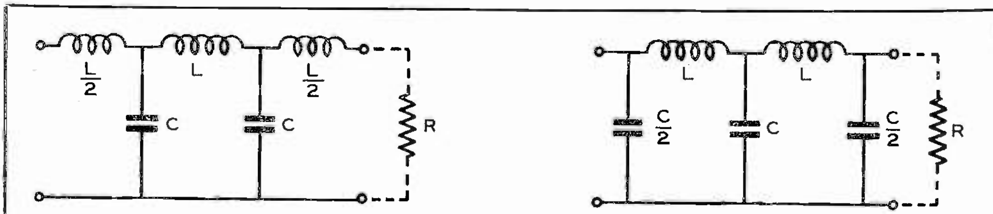
By connecting 40 on the frequency scale to 3000 on the right side of the load scale, we find that a straight-edge intersects the left-center scale at 24 henries. By connecting 40 on the frequency scale to 3000 on the right side of the load scale, we find that the straight-edge intersects the right-center scale at 2.6 mfd. But as a 2.6 mfd condenser is not likely to be available, let us see what cut-off frequency would be provided by a 2.5 mfd condenser and what would then be the proper inductance.

These calculations apply directly to filters which are designed solely for the purpose of eliminating undesired frequencies. They can also be applied to the design of a "brute-force" filter which consists essentially of two π-type sections with larger-than-calculated values for the two condensers, which also act as buffer and power-storage units. But that is another story.

Bandwidth Control Filter

WHAT values of L and C are required in a filter to cut-off frequencies higher than 3000 cycles in 500-ohm line between a speech-amplifier and a high-level modulator in a 'phone transmitter?

This is also a low-pass filter. Its cut-off frequency is 100 times greater than the 30 cycles shown on the frequency scale, which requires that the L and C values shown on the chart be divided by 100. But the load is 1/10 the 5000-ohm load shown on the chart, which requires that the above value of L/100 be divided by 10, thus giving the inductance in millihenriies instead of henries. The above value of C/100 should, for the 500-ohm load, be multiplied by 10, thus giving C/10 as the value for the capacitance, i.e., the chart reading should be divided by 10.



COMBINATION OF 2 T-TYPE SECTIONS

COMBINATION OF 2 π-TYPE SECTIONS

Fig. 2 LOW-PASS FILTER SECTIONS

Upon connecting 2.5 on the right-center scale with 3000 on the right-load scale the straight-edge will be seen to intersect the frequency scale at 42 cycles. This is far enough from the undesired 120 cycle to insure good results and may be selected as the practical cut-off frequency. Then on connecting 42 on the frequency scale to 3000 on the left side of the load scale, we find that the left-center scale is intersected at 23 farads.

As these values of L and C are good for either T- or π-type filters, the next step is to decide which type to use. For a low-pass T-section each of the two series elements is seen to have a value of $L/2 = 11.5$ henries, and the shunt arm to have a value of $C = 2.5$ mfd. For the low-pass π-type, the one series element has a value of $L = 23$ henries, and each of the two shunt elements a value of $C/2 = 1.25$ mfd. As later study of the performance curves will show that both types have the same effect on phase angle and attenuation, final decision as to which to choose is largely a matter of dollars and cents. From the curves it will be found that much better results can be secured by combining two sections, as shown in Fig. 2.

By connecting 30 on the frequency scale with 5000 on the left side of the load scale, corresponding to 3000 cycle value for the cut-off frequency, and the 500-ohm value for the load, the straight-edge will cut the inductance scale at 53, thus calling for 53 millihenries. Likewise upon connecting 30 on the frequency scale with 5000 on the right side of the load scale, the straight-edge will cut the capacitance scale at 2.1, thus calling for a 0.21 mfd condenser, an odd size.

By selecting a standard 0.2 mfd condenser for C, we find that the cut-off frequency is 3100 cycles, and that the corresponding inductance is 50 millihenries. This calls for two 25 millihenry coils with a 0.2 mfd condenser in a T-type section, or one 50 millihenry coil with two 0.1 condensers in a π-type section.

Band-pass filters are somewhat more complicated in design, inasmuch as they have two sets of cut-off frequencies, a low and a high. A low-pass filter is a band-pass section with a low cut-off at zero and a high-pass filter is a band-pass section with a high cut-off at infinity. A simple form of band-pass filter can be made by connecting a low-pass section in series with a high-pass section, provided that the higher cut-off frequency be twice as great as the lower.

No further examples should be needed to enable the reader to solve any problem in the design of low- or high-pass sections in the same manner as illustrated above, using the left-side frequency scale for low-pass and the right-side frequency scale for high-pass.

Design Formulas

THE chart gives approximate results which can easily be checked by the following formulas:

Low-Pass Section: $L = R/\pi f_c$, $C = 1/\pi f_c R$.

High-Pass Section: $L = R/4\pi f_c$, $C = 1/4\pi f_c R$

where L is in henries, C in farads, R in ohms, and f_c, the cut-off frequency, is in cycles per second.

Verification of these formulas for the values of L and C depends upon proving that the resistance to the current which is delivered to a load by either a T- or a π-type section is given by

$$R = \sqrt{L/C} \quad \text{.................... (1)}$$

and that the resonant frequency for a high-pass filter is given by

$$f_o = 2f_c \quad \text{.................... (2)}$$

where f_o is the resonant frequency and f_c is the cut-off frequency, whilst that for a low-pass filter is given by

$$f_o = \tfrac{1}{2} f_c \quad \text{.................... (3)}$$

These proofs are given below. It may here be noted that eq(2) and (3) show that the cut-off frequency for a high-pass filter is ¼ of that for a low-pass filter, which explains the double frequency scale in Fig. 1. Supplementing these equations we also have the well-known formula

$$f_o = \frac{1}{2\pi\sqrt{LC}}$$

$$\text{whence } \sqrt{C} = \frac{1}{2\pi f_o \sqrt{L}} \quad \text{.................... (4)}$$

$$\text{and } \sqrt{L} = \frac{1}{2\pi f_o \sqrt{C}} \quad \text{.................... (5)}$$

Anticipating the proof of eq(1), (2) and (3) we have from eq(1) and (4)

$$\sqrt{L} = R\sqrt{C} = \frac{R}{2\pi f_o \sqrt{L}}, \text{ whence } L = \frac{R}{2\pi f_o}$$

Likewise from eq(1) and (5) we have

$$\sqrt{C} = \frac{\sqrt{L}}{R} = \frac{1}{2\pi f_o R \sqrt{C}}, \text{ whence } C = \frac{1}{2\pi f_o R}$$

Upon replacing f_o by $2f_c$ from eq(2) in these formulas for L and C, we have

$$L = \frac{R}{4\pi f_c} \text{ and } C = \frac{1}{4\pi f_c R}$$

for a high-pass filter. Likewise upon replacing f_o by $\tfrac{1}{2}f_c$ from eq(3), we have

$$L = \frac{R}{\pi f_c} \text{ and } C = \frac{1}{\pi f_c R}$$

for a low-pass filter.

These values of L and C are for the total inductance or capacitance in the series or shunt arms. By referring to the filter circuit diagrams in Fig. 1 it may be noted that in order to provide a total inductance of L in the series arm of a low-pass T-section, each of the two coils in series must have an inductance of L/2; the single condenser in the shunt arm has a value of C. For the high-pass T-section with two condensers in series in the series arm, each condenser must have a capacity of 2C in order to give a total capacity of C; the single coil in the shunt arm has an inductance of L. For the case of the low-pass π-type, the single coil in the series arm has an inductance of L, and each of the two condensers in parallel in the shunt arm has a capacity of C/2. Likewise for the high-pass π-type, the single condenser in the series arm has a capacity of C, and each of the two coils in parallel in the shunt arm has an inductance of L/2.

Proof of the impedance equations is based on the assumption that the resistance of the load is equal (or matched) to the internal reactance of the filter section, thus providing maximum transfer of power and eliminating the effects of reflected currents. This assumption ignores the reactance of the load and the resistance of the filter section, and thus pre-supposes an ideal condition which cannot be realized in practice. But inasmuch as these two sets of neglected factors tend to cancel one another and as the values of constructed coils and condensers are seldom the same as specified, the formulas are universally used for figuring filter design and performance.

Economy in thought may be promoted by first solving for general cases of T- and π-types and then substituting the values of L and C which provide either high-pass or low-pass sections. In so doing, let the series impedances be designated by x, the shunt impedances by y, the load resistance by R, and the internal impedance by Z.

Impedance of T-Sections

THE two T-type sections in Fig. 1 can then be represented by Fig. 3(a), whose equivalent circuit is shown in Fig. 3(b). The equivalent circuit shows x/2 to be in series with a parallel circuit consisting of y and (R+x/2). The impedance of the parallel circuit is found by solving for U in the equation

$$\frac{1}{U} = \frac{1}{y} + \frac{1}{R + x/2} = \frac{2y + x + 2R}{xy + 2yR}$$

This parallel circuit is in series with x/2 to give a total impedance

$$Z = \frac{x}{2} + U = \frac{x}{2} + \frac{xy + 2yR}{2y + x + 2R}$$
$$= \frac{xy + x^2/4 + xR/2 + yR}{x/2 + y + R}$$

Upon substituting Z for R, under the specification that they be matched, and upon solving for Z, we have

$$Z = \frac{xy + x^2/4 + xZ/2 + yZ}{x/2 + y + Z}$$
$$= \sqrt{xy}\ \sqrt{1 + x/4y}$$

For the low-pass T-type section in Fig. 1, $x/2 = \omega L/2$ and $y = -1/\omega C$. Consequently

$$\sqrt{xy} = \sqrt{-\omega L/\omega C} = \sqrt{-L/C}$$
$$\sqrt{1 + x/4y} = \sqrt{1 - \omega^2 LC/4} = \sqrt{1 - f^2/4f^2_o}$$

where $f^2_o = 1/2\pi LC$ gives the resonant frequency f_o.

The cut-off frequency, f_c, marks the boundary between the frequencies which are passed and those which are by-passed, and is that frequency for which the impedance is zero. As L/C is not zero, we have, upon substituting f_c for f,

$\sqrt{1 - f^2_c/4f^2_o} = 0$, whence $f_c/2f_o = 1$ and $f_c = 2f_o$.

Finally, upon substituting f_c for $2f_o$ in the equation for Z, we get

$$Z = \sqrt{-L/C}\ \sqrt{1 - (f/f_c)^2}$$
$$= \sqrt{L/C}\ \sqrt{(f/f_c)^2 - 1} \quad \text{.................} (6)$$

As will later be explained more fully, the factor $\sqrt{L/C}$ has the nature of a resistance to the real current which is passed to the load, and the factor $\sqrt{(f/f_c)^2 - 1} = j\sqrt{1 - (f/f_c)^2}$, where $j = \sqrt{-1}$, represents either the opposition to the wattless current which is by-passed from the load, or the phase displacement of the real current. In all this discussion $\omega = 2\pi f$, $\omega_o = 2\pi f_o$, and $LC = 1/\omega^2_o$.

For the high-pass T-section, $x/2 = 2C$ with a total series reactance of $x = -1/\omega C$, and $y = \omega L$. Consequently,

$$\sqrt{xy} = \sqrt{-\omega L/\omega C} = \sqrt{-L/C}$$
$$\sqrt{1 + x/4y} = \sqrt{1 - 1/(4\omega^2 LC)} = \sqrt{1 - (f_o/2f)^2}$$
$$\text{whence } Z = \sqrt{-L/C}\ \sqrt{1 - (f_o/2f)^2}$$

For zero impedance $f = f_c$, as before, and we have $(f_o/2f_c)^2 - 1 = 0$, whence $f_c = f_o/2$. This proves eq. (2).

In terms of the cut-off frequency, the internal impedance of a high-pass T-section is thus

$$Z = \sqrt{L/C}\ \sqrt{(f_c/f)^2 - 1}$$

As in the case of a low-pass current filter, its resistance to the current passed to the load is expressed by $R = \sqrt{L/C}$.

Impedance of π-Type Sections

BY USING the generalized designations for series and shunt elements, the π-type filter sections in Fig. 1 can be represented by Fig. 4(a), whose equivalent circuit is shown in Fig. 4(b). The impedance of the parallel arm consisting of 2y and R

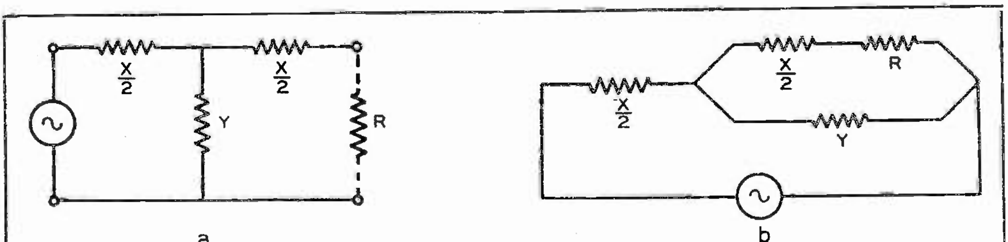


Fig. 3—Generalized T-type Section and Equivalent Circuit Diagram

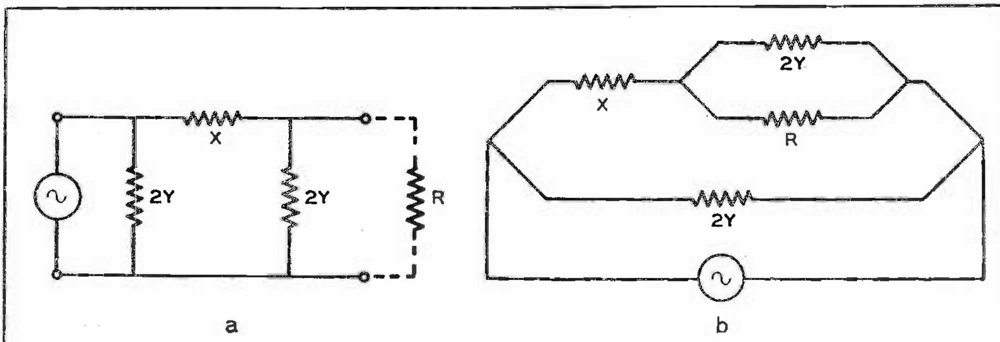


Fig. 4—Generalized π-type Section with Equivalent Circuit Diagram.

in Fig. 4(b) can be found by solving for U in the equation

$$\frac{1}{U}=\frac{1}{2y}+\frac{1}{R}=\frac{R+2y}{2yR}$$

U is connected in series with x to give an impedance

$$W=U+x=\frac{2yR}{R+2y}+x$$
$$=\frac{2yR+xR+2xy}{R+2y}$$

W is connected in parallel with 2y to give the total impedance found by solving for Z in the equation

$$\frac{1}{Z}=\frac{1}{W}+\frac{1}{2y}=\frac{R+2y}{2yR+xR+2xy}+\frac{1}{2y}$$
$$=\frac{4yR+4y^2+xR+xy}{2y(2yR+xR+2xy)}$$

Upon substituting Z for R it can easily be found that

$$Z=\frac{\sqrt{xy}}{\sqrt{1+x/4y}}$$

For the low-pass π-type in Fig. 1, x = L with a series reactance of ωL, and 2y = C/2, whence the shunt reactance is —1/ωC. Consequently,

$$xy=\sqrt{-\omega L/\omega C}=\sqrt{-L/C}$$
$$\sqrt{1+x/4y}=\sqrt{1-\omega^2 LC/4}=\sqrt{1-(f/2f_0)^2}$$
$$=\sqrt{1-(f/f_c)^2},$$

since we have already found that $f_c = 2f_0$ for a low-pass filter. For the total impedance we finally have

$$Z=\frac{\sqrt{-L/C}}{\sqrt{1-(f/f_c)^2}}=\frac{\sqrt{L/C}}{\sqrt{(f/f_c)^2-1}}$$

where $\sqrt{L/C}=R$ represents the resistance to the current which is passed to the load.

For the high-pass π-type in Fig. 1, x = C with a series reactance of —1/ωC, and 2y = 2L, whence the shunt reactance is ωL. By following the procedure previously employed we can readily find that

$$Z=\frac{\sqrt{L/C}}{\sqrt{(f_c/f)^2-1}}$$

where $\sqrt{L/C}=R$ represents the resistance to the current which is passed to the load.

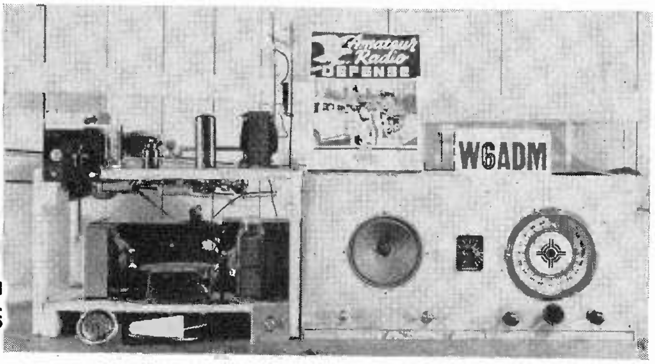
Conclusion

THE preceding analysis rigorously proves eq(1), (2) and (3), which are the bases for the design formulas and the calculating chart. The proof could have been presented in simpler form were it not for the fact that the impedance expressions are also the foundation for determining the performance characteristics, which will be given in the next installment. This will include a simple chart for figuring phase shift and attenuation. Use of this chart, like that of the design chart, requires no knowledge of mathematics. Proof of its validity can be understood by anyone who has taken a course in high school trigonometry. This proof is much simpler than any which has come to the attention of the writer.

38 Contestants in 2½-Meter Survey

No LONGER will be the amateur be content with calling "CQ CONTEST" in the u.h.f. region. No longer will he engage in 2½-meter competition for the "fun of it." For he has a new goal, a new motive for his experiments; he has become defense-minded. Quick to realize that they can be of increasingly greater service to those in our military forces in the respective areas, and this data will then be kept up-to-date with a running series of tests, every 30 days, so that the service will be available at any and all times. Thus the amateur will prove his worth to the military forces, and similar tests will soon be conducted on all other amateur bands with the same objective in view. Future tests in the u.h.f. region will be called to the attention of the military

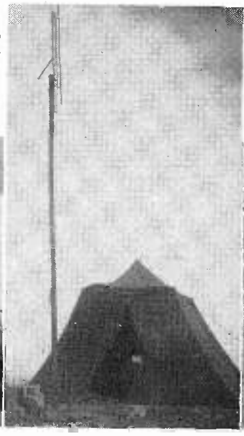
Al Muno, second op at W6ADM. Co-holder of 255 mile record.



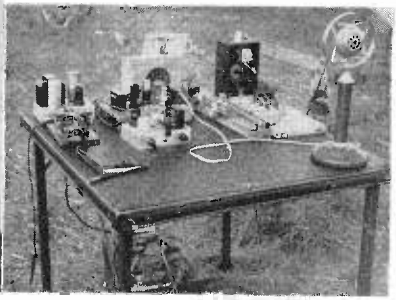
Floyd Barnes, W6ADM, winner of first Test & Survey.

whose hands the destiny of the nation lies, amateurs along the Pacific Coast have chosen to make their 2½-meter operations valuable from the standpoint of plotting the terrain, mapping the communication channels, recording the conditions of the band in daylight and after dark, and logging all of the unusual conditions of the u.h.f spectrum. Once compiled, the data will be presented to forces so that Governmental Officials can accompany the amateurs when these tests are conducted, in order to give advice, lend aid and cooperate in numerous ways to make the surveys more effective and valuable. Because we now have a mission to perform, the activity in the u.h.f. region has reached an all-time high on the Pacific Coast, and it is hoped that similar tests will be conducted

Below: First operator, R. Davis, W6NJJ (right) and second operator, Bill Vincent, testing W6NJJ prior to the start of the Test. The station was located atop Mt. St. Helena, Cal.



Equipment used by W6NJJ, holder of second highest score in the Test. The transmitter includes an HY-75 triode and Vibrapack Power Supply, Field-strength meter is also shown.



monthly in other sectors of the United States, so that it will be possible to furnish the military services with charts, maps, graphs and information on u.h.f. conditions in all strategic points in the nation. The Pacific Coast was first to engage in this plan only because Amateur Radio Defense Association was just recently organized in the West, yet it is sincerely hoped, and expected, that other amateurs in every part of the U. S. A. will immediately undertake similar u.h.f. surveys and tests, and report the findings each month to this magazine, so that publication of the information can be made quickly and consistently. Photographs are requested, together with lists of calls of participating stations, and all pertinent information having to do with the tests and their results. This information will form the basis for a National U.H.F. Survey Department, which you will find in each succeeding issue of this magazine.

The Coast's first Test and Survey was of an experimental nature, merely to determine how many stations would participate, and to what extent the amateur would go in order to perform a service under difficult and trying conditions atop mountains, hills, and in remote places. So successful was the inaugural test that another, to be held on November 24th, is expected to include more than 100 participants, in all parts of California. An attempt will be made to cover the entire state with a 2½-meter network. Amateurs who desire to join the November test are urged to write this magazine at once for application blanks, rules and regulations, log sheets, etc. Your communications should be addressed to Montague T. Bancroft, W6NJW, Amateur Radio Defense, Monadnock Building, San Francisco, California. Amateurs in other States may also secure information and printed matter free of charge, so as to carry this plan into every part of the U. S. A.

The Inaugural Test and Survey

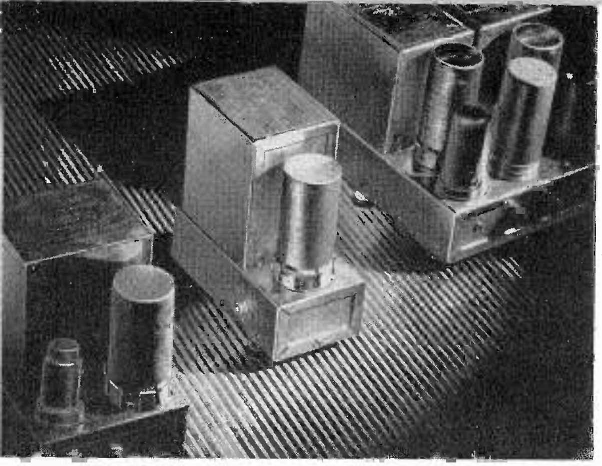
ALTHOUGH publicity for the first Test and Survey was by word-of-mouth and through radio dealer cooperation only, a total of 38 stations participated, all on 2½-meters. Activity was confined principally to the San Francisco Bay area; however, W6DOK, W6DJJ, and W6TDJ, all in Southern California, also participated, yet this was not known to the Northern amateurs because information was received too late. The Test was in charge of Montague T. Bancroft, W6NJW, San Francisco's Local U.H.F. Communication Coordinator, temporarily appointed, for Amateur Radio Defense Association. The selection of a permanent Officer for the area will be made when all available members have been enrolled into the U.H.F. Division. *Certificates of Skill* will be awarded each month to operators whose feats of accomplishment are outstanding.

Don C. Wallace, W6AM, with his son and chum. All are enthusiastic UHF fans. The photograph shows them on the peak of one of Southern California's mountains, ready to get-in on 2½-meter DX.

The inaugural Test was held on Sunday, October 20th. Stations were erected atop strategic mountains, and mobile units operated from many hillsides and other favorable locations. The band was so congested with signals that even the confirmed men of U.H.F. were taken by surprise. Numerous 2½-meter sets were assembled hurriedly in order to get in on the Test. Activity continued unabated from 6:00 A. M. until midnight. Each participant was required to keep an accurate Log and Score Sheet. Points were awarded on the basis of air-mile contacts, credit given for one contact only with stations in a particular locality. If three stations were contacted in San Francisco, for example, only one score was accredited.

Winner of the Test is Mr. Floyd Barnes, W6ADM, of Santa Rosa, California, whose 2½-meter station was in operation atop Mt. St. Helena, 4343 feet above sea-level. With the aid of a directional rotary array and a medium-power transmitter he accumulated a total of 987 mile-points. His best DX contact was with W6GKJ, on Mt. Hamilton, 101 miles distant. Mr. Barnes writes that two of his contacts were with stations of a doubtful nature, whose call letters were not found in the *Call Book*, and no mile-point scores were claimed for these dubious contacts. A warning is given here to all participants in future Tests—make sure your operation is legal, because drastic steps will be taken

(Continued on page 76)



The Author

R. M. Ellis, W9YSA, continues his treatise on the Vibrapack, one of the most widely required units for portable equipment, particularly that used for Defense service.

Vibrapack Power Supplies

Part II

Rectification

VIBRAPACKS are built in both the sychronous, or self-rectifying types, and in the tube rectifier types. An understanding of the characteristics of each type is desirable to permit the selection of the best and most economical type of Vibrapack for the application.

By building an extra set of contacts on the reed, the motion of the vibrator reed not only inverts the DC input, but also rectifies the high voltage output as previously explained. There is one point that should be noticed—with this system one leg of the storage battery circuit is common with B—.

Consequently, when using a self-rectifying Vibrapack, a filter choke or bias resistor cannot be incorporated in negative "B" circuit. This is a limitation and constitutes the reason why Vibrapacks are offered in both the tube and self-rectifying types. When the B— circuit can be at ground potential, and common with one terminal of the storage battery, the self-rectifying type power supply is fully as reliable and is somewhat more economical and compact than the tube rectifier types. Self-rectifying Vibrapacks give excellent results in CW transmitters, even when the design of the rig is such that the plate current drops to a comparatively low value when the transmitter is in a key-up condition. With Vibrapack VP-552, a 10 ma. bleeder is adequate to protect the filter condensers, when high grade 450 working volt dry electrolytic condensers are used.

Tube Rectifiers

Two types of tube rectifiers are used in Vibrapacks—the 6X5 and the OZ4. The characteristics of the 6X5 tube are standard, and it is suffice to say that the sole disadvantage of this tube is its .6 ampere heater current drain. The 6X5 rectifier tube is supplied as standard equipment with Vibrapacks types VP-551 and VP-557.

The OZ4 tube is supplied with Vibrapacks types VP-554, VP-555 and VP-F558. This rectifier tube is very efficient—it has a very low voltage drop and requires no separate source of heater power.

There are two precautions to be observed in using the OZ4 rectifier tube.

1. The minimum load current of the OZ4 is 30 milliamperes.

2. On CW rigs this minimum current requirement must be satisfied with the transmitter in a key-up condition.

Mallory Vibrapacks types VP-554 and VP-555, normally fitted with OZ4 tubes can be used with 6X5 tubes without changes. Conversely an OZ4 tube can be used in type VP-553 when the minimum load requirements of the tube exist.

It is not practical to install OZ4 tubes in the 400 volt Vibrapack, type VP-557, because they will be overloaded, nor is it practical to install a 6X5 tube in the 32-volt Vibrapack since no provision exists to provide heater voltage.

Parallel Operation

The practical maximum current limit for a heavy duty vibrator is about 7½ amperes at 6.3 volts, for continuous operation, and in a well designed vibrator power supply this will produce an output of about 32.5 watts. Where greater outputs are required two single-unit Vibrapacks may be operated in parallel, or a dual Vibrapack may be used.

Parallel operation of standard single unit Vibrapacks is practical, providing the proper circuit is employed. Each Vibrapack must be individually fused in the input circuit.

In the output circuit each Vibrapack should be provided with its individual filter condenser choke. The output ends of the two chokes may be connected together and bypassed with a common condenser. Vibrapacks for parallel service may be of the self-rectifying type; or if the tube rectifying type is used, 6X5 rectifiers should preferably be installed. The employment of OZ4 rectifier tubes requires sufficient DC resistance in the filter circuits to insure positive ignition of both tubes.

Dual Vibrapacks

Two Vibrapacks are available for dual operation; type VP-555 with a rated output of 300 volts at 200 ma. and type VP-557 with a rated output of 400 volts at 150 ma. Since there is some difference in the design of these two Vibrapacks, they will be discussed separately.

Vibrapack Type VP-555

This Vibrapack with its output of 300 volts at 200 ma. finds principal application in the operation of phone transmitters and public address amplifiers. Sufficient power is available to drive a 6L6 push-pull audio amplifier to an output of approximately 20 watts, thus making possible the construction of economical and thoroughly effective automobile P. A. systems.

To provide minimum current drain and maximum overall efficiency this Vibrapack is supplied with OZ4 tubes. The use of these tubes is permissible because special balancing resistors are included in the DC output circuit, which provides for the positive ignition of both tubes and the uniform distribution of load. These resistors being heavily bypassed provide a filtering effect so that the output ripple is only about 1½ per cent at maximum load. This is sufficiently low to permit the direct feeding of an amplifier output stage. In a high-gain audio amplifier, supplemental filtering is desirable for the voltage amplifier stages, and this is generally automatically provided by the RC filters incorporated in the amplifier for decoupling purposes.

Minimum Load Requirements

When using OZ4 tubes in the VP-555, a total minimum starting load of 140 ma. is required; thereafter the load current may drop to as low as 75 ma. If the circuit is such that this minimum load current cannot be maintained, 6X5 or 6W5 tubes should be substituted. No change in wiring is required. Heater type rectifiers are also recommended when this Vibrapack is used for CW transmitter service. Note: The heater circuit of the VP-555 connects to a separate terminal. When using 6X5 or 6W5 tubes in the Vibrapack, the heater circuit can be connected in parallel with the tube filaments of the transmitter so that instant output will be available on application of power. This feature is also provided in the dual Vibrapack, type VP-557. When using OX4 tubes in VP-555, the heater binding post is simply left unused.

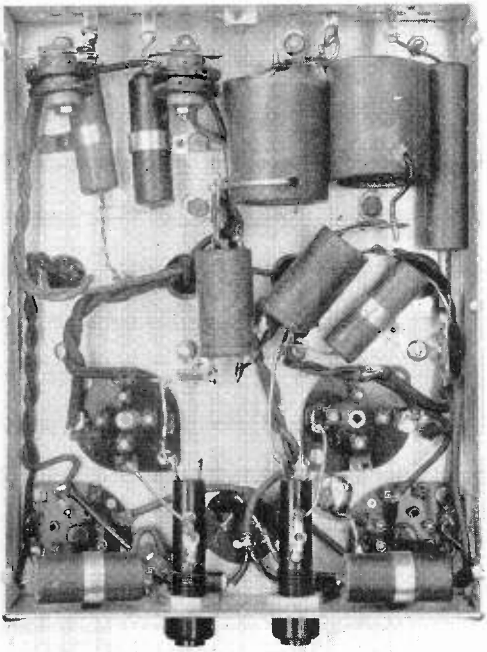
Vibrapack Type VP-557

Vibrapack Type VP-557 was designed especially for communication service and its output of 400 volts at 150 milliamperes conveniently serves many of the available medium power transmitting tubes.

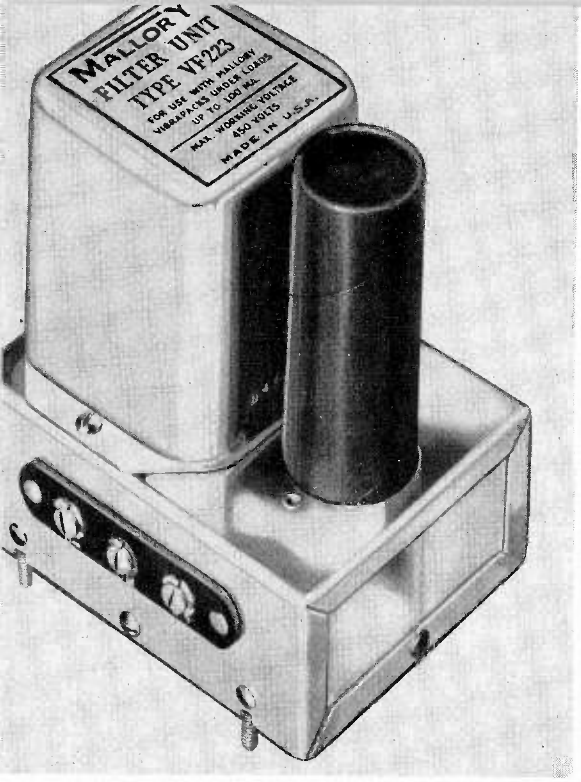
Two 6X5 rectifier tubes are used, and the heaters of these tubes connect to a separate binding post on the terminal strip. For communication service these heaters may be connected in parallel with the 6.3 volt filaments of the transmitter. When the Vibrapack is used with a P.A. amplifier, or for other applications where the instant availability of power is not required, and the few seconds delay required for the heating of the rectifier tubes is unobjectionable, the "Fil" terminal can be connected to the "A Hot" terminal by means of a short wire jumper.

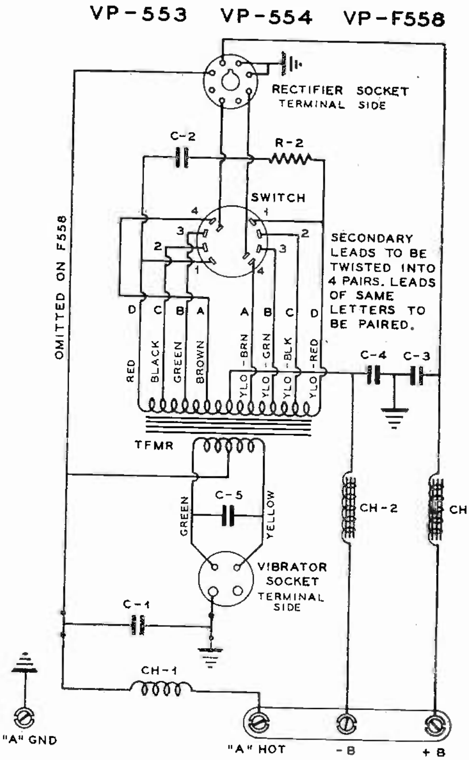
Filter System

On this Vibrapack only the first input filter condenser is included, and the filter-



Bottom View of Vibrapack Unit





ing should be completed by the addition of a filter choke and output condenser which may, if desired, be mounted on the amplifier or transmitter chassis. The selection of a suitable choke and filter condenser is quite easy—components which would be selected for use in an equivalent "AC" power supply will work perfectly.

Minimum Load Requirements

The minimum load for Vibrapack VP-557 should not be less than 25 milliamperes, since loads below this value will result in voltages which are sufficiently high to strain the cathode-heater insulation of the rectifier tubes. This minimum load requirement can be maintained by means of a bleeder; or the circuit may be such that the load of a tube, such as the crystal oscillator, may be kept continuously on the circuit.

Important Note on C.W. Transmitters

With one important exception, any of the conventional keying circuits can be used in a Vibrapack operated transmitter. This important exception is that the key *should never be placed in the circuit between the battery and the Vibrapack.* The Vibrapack must operate continuously during the period of transmission. Switching in the 6 volt circuit is permissible for break-in phone operation, and power is instantly available on closing the switch; provided, of course, that the rectifier tube cathodes are kept heated.

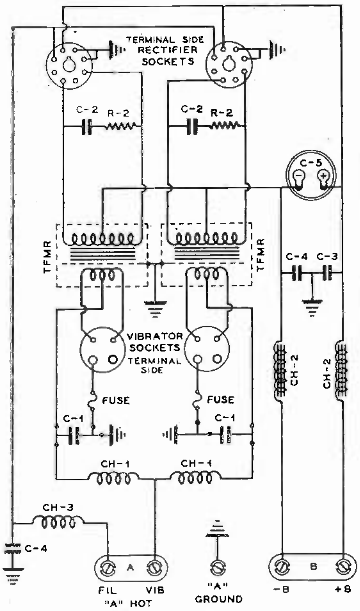
LEGEND	VP-553 MALLORY PT. No.	VP-554 MALLORY PT. No.	VP-F558 MALLORY PT. No.
TRANSFORMER	B-40966-2	B-40966-1	B-40966-4
C-1	RF-481	RF-481	RF-481
C-2	A-40980-1	A-40980-1	———
C-3	TP-415	TP-415	TP-415
C-4	TP-438	TP-438	TP-438
C-5	———	———	TP-443
CH-1	RF-582	RF-583	RF-582
CH-2	A-40919-1	A-40919-1	A-40919-1
R-2	———	A-40389-3	———
RECT. TUBE	TYPE 6X5	TYPE 0Z4	TYPE 0Z4
TUBE SOCKET	A-40978-1	A-40978-1	A-40978-1
VIBRATOR	TYPE 825	TYPE 825	TYPE F826
VIB. SOCKET	A-15211-1	A-15211-1	A-15211-1
TERM. STRIP	A-40943-1	A-40943-1	A-40943-1
SWITCH	B-111202-1	B-111202-1	B-111202-1

Installation Instructions

The Vibrapack can be easily installed and will give long life and satisfactory performance if the following installation and operation instructions are carefully observed.

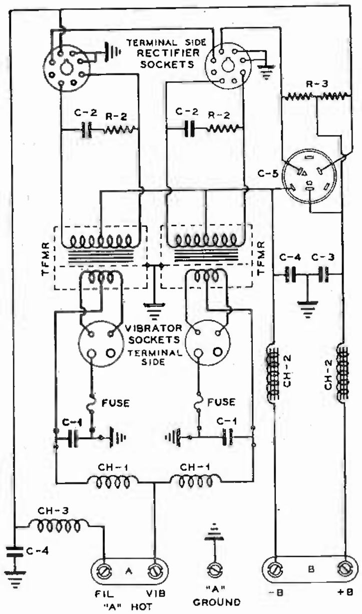
Mounting

The Vibrapack has been designed to mount directly on the chassis of a receiver, transmitter, amplifier or other equipment without transmission of objectionable hum, or introduction of circulating "ground currents" which would produce "hash interference." Mounting in this manner is accomplished by



VP-557

LEGEND	VP 555 MALLORY PT. No	VP 557 MALLORY PT. No
TRANSFORMER	B-44247-1	B-44247-2
C-1	RF481	RF481
C-2	A-40980-6	A-42086-1
C-3	A-42080-2	A-42080-2
C-4	A-42080-1	A-42080-1
C-5	101411	X-26080
CH-1	A-40784-1	A-40784-1
CH-2	A-42083-1	A-42083-1
CH-3	A-42092-1	A-42092-1
R-2	A-40389-3	A-40389-3
R-3	A-40389-4	
FUSE	3AG 12 AMP	3AG 12 AMP
VIBRATOR	TYPE 825	TYPE 825
VIB. SOCKET	A-15211-1	A-15211-1
TUBE SOCKET	A-40978-1	A-40978-1
RECT. TUBE	0Z4 A-40977-2	6X5 A-40977-1
TERM STRIP "A"	A-40922-5	A-40922-5
TERM STRIP "B"	A-40922-4	A-40922-4



VP-555

drilling four ½-inch holes (six holes for dual Vibrapacks), which line up with spade bolts attached to chassis of the Vibrapack. The rubber grommets furnished are inserted in these holes and the Vibrapack mounted thereon, with the cup washers placed on both sides of the grommets for distribution of the load before the nut is placed on the spade bolt. This insulates the Vibrapack from the chassis both electrically and mechanically. IT IS IMPORTANT THAT THE VIBRAPACK BE MOUNTED IN THIS MANNER IF "VIBRATOR HASH" IS TO BE REDUCED TO A MINIMUM.

How to Connect the Vibrapack

The connections made to the Vibrapack are "A Hot," "A Ground," "B+" and "B—."

Provision is made for correct operation of all types of Vibrapacks on battery grounds of either positive or negative polarity. Special Mallory synchronous vibrators on Types VP-551, VP-552 and VP-G556 are reversible. By determining the polarity of the grounded side of the battery and following label directions, the "B" voltage will be properly polarized. Special Mallory Vibrators on tube-rectifier type Vibrapacks do not require polarization of output. On types VP-551, VP-552 and VP-G556, "A" ground and "B—" must be connected to the chassis itself, as they are common and at ground potential. On tube rectifier type Vibrapacks, only "A" ground must be connected to the chassis, as "B" may float if desired on these types. Grounding of the Vibrapack chassis is best accomplished by soldering a heavy strip of stranded braid on the chassis at the screw located directly under the terminal board, or between the terminal boards on the dual units. The length of this lead must be kept at a minimum for best results. GROUND VIBRAPACK CHASSIS ONLY AT THIS ONE POINT.

Fuses

Dual Vibrapack Types VP-555 and VP-557 are protected by two 3AG 12 ampere fuses, mounted in compression type low resistance bakelite holders, and external fusing is unnecessary.

Single unit Vibrapacks should be protected by an external fuse. The following sizes are recommended:

VP-551, VP-553—5 to 7½ amp.
VP-552, VP-554, 10 to 15 amp.
VP-G556, 7½ to 10 amp.
VP-F558—3 to 5 amp.

Either screw-type household fuses or automotive radio type fuses may be used. Automotive fuses should be mounted in bayonet-locking, compression type holders to prevent excessive voltage drop.

Audio or Hum Filter

Since the output of a vibrator power supply is pulsating direct current some form of audio filter is required before the power can be used. Two factors make filtering requirements comparatively simple—the high frequency of the vibrator (115 cycles) as compared with the frequency of commercial alternating current, and the flat-topped wave form, with a proportionately small period of interruption where no current is flowing. Proper operating conditions require a condenser-input or pi-section filter; however, with the flat-topped wave form, regulation does not suffer as would be the case with a sine wave input. The input condenser connected across the terminals of the Vibrapack should have a value of 8 mfd. or more.

The selection of a suitable filter choke is simple in that any choke suitable for an equivalent A.C. power supply will operate perfectly. To prevent loss of power in the choke, and to provide the best regulation, the choke should have the lowest practical D.C. resistance.

Mallory VF-223 Filter Unit

An example of a well designed Vibrapack filter is the VF-223 filter unit which is provided for those who desire a de luxe filter with a physical appearance to match the single unit Vibrapacks.

The choke is rated at 3.5 henries, 90 ohms DC resistance, and the core is air gapped to prevent saturation effects.

The filter condenser is a three section Mallory FPT390, of 15-15-10 mfd. 450 working volt capacity. The two 15 mfd. sections are used with the choke to form a conventional pi-section filter, while the third 10 mfd. section connects to a separate terminal so that if desired a filtered intermediate output voltage can be obtained.

Connections

The VF-223 is provided with two terminal boards. The terminal board with two connections is the input. "B plus" of the VF-223 input is connected to "B plus" of the Vibrapack. "B minus" of the VF-223 input is connected to "B minus" of a tube type Vibrapack, or to the metal chassis of a self-rectifying Vibrapack. Output is obtained from the "B minus and B plus" terminals of the triple terminal board.

If an intermediate voltage is not required, connect "B plus" and "BM" together with a short wire jumper, which will increase the capacity of the output section of the filter to 25 mfd.

Intermediate Voltage

In some applications an intermediate voltage may be required. This intermediate voltage can be obtained by using a series dropping resistor connected between the "B plus" and "BM" terminals of the VF-223, or by using a voltage divider resistor connected between the "B plus" and "B minus" output terminals with the tap of the resistor connected to the "BM" terminals. For most applications where only limited dissipation is required, 10 watt resistors may be used and mounted inside the VF-223 chassis. The values of the required resistors can easily be calculated by Ohm's law.

Input Circuit Requirements

To obtain maximum output and greatest efficiency from a Vibrapack installation the power of the storage battery should be delivered to the Vibrapack without excessive loss. The outputs of Vibrapacks are rated with 6.3 volts applied to the Vibrapack terminals. Tests show that a reduction of the input voltage to 5.95 volts will lower the output wattage 10 per cent, while a reduction to 5.65 volts will result in a power output loss of 20 per cent. A Vibrapack is a conversion device—similar in characteristics to an AC transformer—and the input and output potentials will vary proportionately.

Input wiring losses can be kept to a minimum by observing three conditions:

1. Keeping the battery leads as short as possible.
2. Making certain that the switch or relay used to control the circuit has low resistance.
3. Using wire of sufficient size to properly carry the current.

The use of short direct leads is as good a rule for the battery leads as for the general wiring of the transmitter or receiver. If control is required from any location that is not in direct line of the wiring between the battery and the Vibrapack, do not run long leads to the switch. Insert a relay in the circuit. The coil of the relay can be energized through leads of any reasonable length.

Selection of the Correct Relay

The Mallory 754-1 relay is recommended for use with all single unit Vibrapacks. Because its coil resistance is 120 ohms the power demand of this relay is very small—approximately 1/3 watt under normal operating conditions. The relay coil is wound for six volt operations. When using the relay to operate a 12 volt or 32 volt Vibrapack the coil should be energized from three cells of the storage battery. Because the Mallory 754-1 relay is unshielded it is preferably mounted on the chassis of the receiver of transmitter.

For controlling dual unit Vibrapacks types VP-555 or VP-557, a heavier relay than the Mallory 754-1 is required. It has been found that the Delco-Remy Automobile Horn Relay, Part 1116775 is satisfactory and is quite inexpensive. This relay may be purchased from any U.M.S. or Oldsmobile agency. The current drain of the coil is approximately

1.4 amperes at 6.3 volts; and with 17.5 amperes passing through the relay, the drop across the contacts averaged 40 millivolts on several samples tested. Other makes of relays may be used, but care should be taken in selecting units with contacts sufficiently large to handle the required current without sticking, and with a total drop through the controlled circuit at maximum load of less than 50 millivolts.

Selection of Correct Wire Size

The following tables gives the maximum length of leads for connection between the battery and Vibrapacks, with 6.6 volts available at the storage battery terminals. An allowance of 50 millivolts has been made for voltage drop in the control switch or relay contacts. It is assumed that the Vibrapacks are operating into a constant impedance load which at normal input voltage will load the Vibrapacks to their maximum rating.

Vibrapacks Types VP-552 and VP-554

Wire Size B.&S. Gauge	Max. Length of Lead That Will Give Rated Output Each Lead	Length of Lead Which Will Reduce Output Watts 10 Each Lead
No. 14	2.5 ft. long	7.5 ft. long
12	4.0 ft. long	13.5 ft. long
10	6.0 ft. long	22.0 ft. long
9	8.0 ft. long	28.0 ft. long
8	10.0 ft. long	35.0 ft. long
7	12.0 ft. long	44.0 ft. long
6	15.5 ft. long	55.0 ft. long
4	21.0 ft. long	72.0 ft. long

Vibrapacks Types VP-555 and VP-557

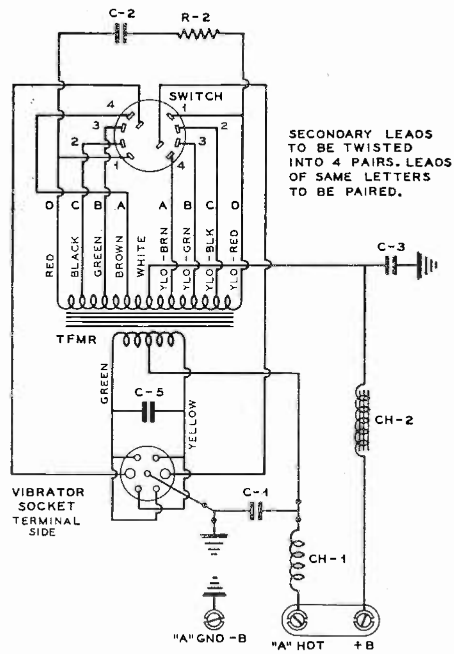
Wire Size B.&S. Gauge	Max Length of Lead That Will Give Rated Output Each Lead	Length of Lead Which Will Reduce Output Watts 10 Each Lead
No. 14	Not Recommended	
12	2.0 ft. long	
10	3.0 ft. long	7.0 ft. long
9	4.0 ft. long	11.0 ft. long
8	5.0 ft. long	14.0 ft. long
7	6.0 ft. long	22.0 ft. long
6	7.5 ft. long	27.0 ft. long
4	10.0 ft. long	36.0 ft. long
2	14.5 ft. long	52.0 ft. long
0	20.0 ft. long	72.0 ft. long

Please note that the lead lengths listed above are for each lead and that the total lead length can be twice the amount shown. No allowance has been made for additional load, such as tube filaments; and if such a load is present on the leads in addition to the Vibrapack, the maximum lengths of the leads must be shortened accordingly.

Mobile Police Transmitters

In general, if a heavy duty police mobile transmitter and dual Vibrapack types VP-555 or VP-557 are installed in the rear luggage compartment of a sedan, and the storage battery is located in the engine compartment under the hood, No. 2 wire should be used in making the 6 volt connections. Flexible welding cable is excellent. It is preferable to use copper wire for both the "cold" and "hot" leads, rather than relying on the frame of the car to carry the "cold" circuit.

VP-551 VP-552 VP-G556



LEGENO	VP-551 MALLORY PT. No	VP-552 MALLORY PT. No	VP-G556 MALLORY PT. No
TRANSFORMER	B-40966-2	B-40966-1	B-40966-3
C-1	RF-481	RF-481	RF-481
C-2	A-40980-1	A-40980-1	A-40980-1
C-3	TP-415	TP-415	TP-415
C-5	———	———	A-42026-1
CH-1	RF-582	RF-583	RF-583
CH-2	A-40919-1	A-40919-1	A-40919-1
R-2	———	A-40389-3	A-40389-3
VIBRATOR	TYPE 725	TYPE 725	TYPE G725
VIB. SOCKET	A-40921-1	A-40921-1	A-40921-1
TERM. STRIP	A-40922-1	A-40922-1	A-40922-1
SWITCH	B-111202-1	B-111202-1	B-111202-1

Microphone Current

Most radio engineers and public address operators use and prefer the modern crystals, dynamic or velocity microphones which do not require external power.

For the benefit to those who wish to use the older type single and double button carbon microphones, the following precaution should be noted. Microphone current should be obtained from a separate battery (which may consist of flashlight cells) and *not* from the storage battery used to operate the Vibrapack. It is only practical to obtain microphone current from the storage battery if the microphone supply lead is filtered with an iron core choke and high-capacity condenser. Considering the low cost, small size and long life of dry cells in this service, the cost of this filter may not be warranted.

Operation of Vibrapacks on AC Lines

Considerable discussion has occurred at times regarding the operation of Vibrapacks on AC power lines. The possibility of supplying an additional primary winding on the vibrator transformer for connection to 115-volt AC lines has been suggested. The additional AC winding requires considerable window space in the transformer, and a winding for operating the tube heaters is required unless type OZ4 tubes are used. It is felt that for the occasional use to which this winding would be put, its extra cost, space requirements, and other complications, do not warrant its use. It has been determined that if a step-down AC transformer is provided which will supply 10 volts AC, RMS, 60 cycles, at the load current required, easy adaptation of all standard tube rectifier Vibrapacks to AC line service is practical.

This 10 volts is applied to each transformer, across the entire primary, by removing the vibrator and plugging in an adaptor having the AC cord connected to the two small pins of the standard interrupter vibrator base. The value of 10 volts is used instead of the 12.6 volts DC value for the whole primary winding because of the difference in waveform between the sine-wave AC and the square-wave DC. The tube heaters, if desired, may be run from the same AC source with a dropping resistor to reduce the voltage to the correct value. This method allows maximum efficiency to be secured from the vibrator power unit when operating from DC, and still permits AC operation without complicated switching means.

Receiver Operation With Vibrapacks (Sets Using 6.3 Volt Tubes)

While this article has dealt primarily with the use of Vibrapacks for operating transmitters, Vibrapacks are recommended and are widely used for operating radio receivers. Many of the available communication receivers are equipped with special terminals to provide optional operation with either the self-contained AC power supply, or with a Vibrapack mounted externally to the set. Where receivers are not equipped with these special terminals, it is a comparatively easy matter to add to the receiver a double-pole, double-throw switch so that the 6.3 volt heater circuit can be connected either to the filament winding of the power transformer or to the storage battery. B+ connection can be made by a terminal connected to the filament or heater connection of the rectifier tube socket, or alternately a plug-in adapter to replace the rectifier tube can be constructed from a discarded tube base. With this connection the regular filtering of the receiver (filter choke or speaker field, and associated condensers) provide adequate smoothing action to provide practically hum-free performance.

When it is desired to convert an AC receiver for Vibrapack operation only, the power transformer and rectifier tube socket may be removed from the receiver, and the Vibrapack mounted on the receiver chassis in the space formerly occupied by these parts.

About the only change required in the receiver is the addition of a 1/10 mfd. 600 volt paper condenser between the "B+" terminal and the chassis (or at the rectifier tube socket if connection is made at that point). The reason for this is that the electrolytic condensers usually used for receiver filtering have a comparatively high RF impedance since they are usually inductively wound, and consequently offer little suppression to high frequency RF hash which may be fed into the set through the B+ lead. As a final touch, the hot "A" lead of the receiver (not the Vibrapack) may be bypassed to the chassis with a low impedance ½ or 1 mfd. bypass condenser, Mallory types RF481 and RF482 being ideal.

Receiver Operation With Vibrapacks (Sets Using 1¼ Volt and 2 Volt Filament Type Tubes)

An additional problem is presented when it is desired to power a sensitive radio receiver with a Vibrapack if the receiver uses low voltage filamentary tubes. That this problem can be solved without difficulty is attested by thousands of successful Vibrapack installations, as well as the countless farm receivers with built-in vibrator power supplies. However, the methods of solution may not occur to those who have not had experience in this line. The power demand of a Vibrapack is intermittent, and because of the IR drop of the connecting wires and in the storage battery, an AC component will be applied to the filament circuit if the filaments are heated from the same battery as is used to operate the Vibrapack. With filament type tubes the grid returns con-

(Continued on page 71)

An Inexpensive Portable Antenna
(Continued from page 35)

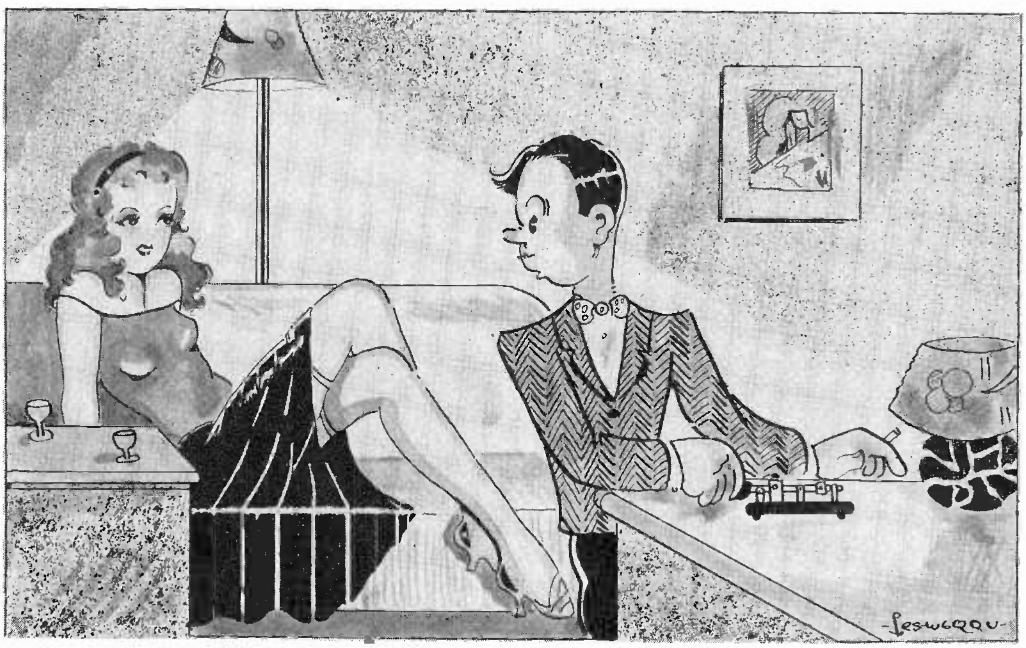
bamboo poles were self-supporting and that they would withstand heavy winds and rough seas, so we experimented with a tight spiral winding. We start the winding at the top of the pole, with no spacing between turns, and as the diameter of the pole becomes greater, we gradually increase the spacing between turns until at the lower end of the pole the turns are about two inches apart. The antenna now represents a loading inductance which radiates appreciably more current than a single-wire of equivalent length. Using an uncalibrated vacuum-tube voltmeter for field strength measurements, it was interesting to observe the increase of carrier strength with antennas as short as six feet, although our tests disclosed that a minimum of twelve feet was needed to radiate a good, readable signal. While the details cannot be divulged at this time, we have developed a collapsible antenna for one of the Coast Artillery units, and it performs extremely well.

Fortunately for most of us who supply radiotelephone equipment to the marine field, boat owners do not object to bamboo antenna masts because they are very handy when used as outrigger fishing poles; they are hinged at the base and thus serve as additional fishing paraphenalia.

For portable-mobile work, we have supplied poles in three equal sections with metal connecting sleeves very similar to standard fishing rod construction.

There are many kinds of wire available for rough usage and weather exposure, although most of the marine service-men use number 14 stranded wire with spun glass insulation. This insulation seems to prevent inter-turn leakage under extreme conditions of moisture, yet the overall diameter is relatively small. On a boat where ground conditions are ideal, we get R5 signals in Southern California in QSO's with Puget Sound, using 15 watts.

While antennas of the foregoing construction do not approximate a quarter wave, they are a step in the right direction, and provide an inexpensive antenna not quite as formidable in appearance as the grotesque objects tied to the end of the windmill-like structures.



Miss Match to Mister Q:

"Did you come up here to telegraph all night?"

Jones 4-Band Antenna

An easily-built high-gain antenna requiring no adjustment for change in band and designed to operate from a non-resonant two-wire feeder.

By Frank C. Jones

CONSIDER an antenna having a 230° radiator instead of the usual 180° or half-wave doublet. At its fundamental frequency regard it as consisting essentially of two half-wave antennas with about one-third of each antenna wire bent downwards parallel to the other in an open-ended stub whose end is connected to a non-resonant feeder line. When the line is inductively coupled to a properly chosen tank coil by means of 1 to 4 turns around its voltage node, the arrangement eliminates the need for an antenna tuning circuit and permits efficient operation on four bands—the fundamental frequency, and the second, fourth and eighth harmonics.

Assume, for example, that the radiation resistance of a half-wave antenna at a certain height above ground or in free space is 73 ohms at the center, and that the apparent radiation resistance at the ends is 2400 ohms. When it is close to another antenna wire, or to ground, the central resistance decreases and the end resistance increases in proportion. Then for two half-wave antennas end-to-end, the radiation resistance at the current loops will be practically twice and at the ends will be one-half as great as that of a single half-wave antenna.

Because the current and voltage values in a resonant antenna follow the sine and cosine law, along the antenna the impedance should approximately follow a tangent or cotangent law. The reactive component of the antenna impedance is zero at the current loops; in design considerations involving non-resonant antenna feeders it is not as important as the resistive component. If the resistive component be made equal to the surge impedance of the r.f. feeders, the transmission line will operate at high efficiency and the standing waves of voltage and current along the transmission line will be relatively small. The reactive component along an antenna at a point of 300 ohms or so each side of the center is relatively small and can be ignored in amateur practice.

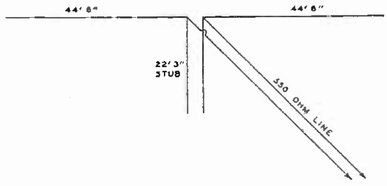
If a 600 ohm two-wire feeder be connected to the antenna in such a way that the apparent radiation resistance is 300 ohms with respect to the current loop point in the antenna, then an imaginary ground plane can be drawn through the center of a half-wave antenna and the radiation resistance each side of this ground plane will be 36 ohms, or a total of 72 ohms. A two-wire or concentric feeder connected into this point should therefore have an impedance of 72 ohms.

If one-half of the half-wave antenna is removed and the other half is worked against actual ground, as in the case of a quarter-wave vertical antenna, the radiation resistance will be 36 ohms and the r.f. feeders should have a surge impedance of 36 ohms, assuming no heating loss in the earth connection.

In the case of a 600 ohm line, each feeder wire connects to a point of 300 ohms resistance with respect to an imaginary ground plane, which gives an effect of 600 ohms termination, since the voltage across the two points will be 180° out of phase.

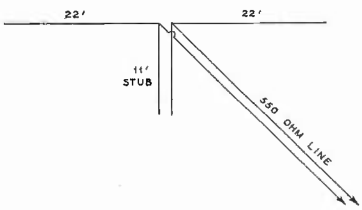
In this new antenna the flat-top portion thus consists of a wire 230° in length with respect to a full-wave of 360°. The actual length in feet can be calculated for any wavelength by means of this relation. The effective termination on the two-wire feeder for the four-band antenna illustrated in the sketch is 600 ohms at 40 meters, 500 ohms at 20 meters, 400 ohms at 10 meters, 440 ohms at 5 meters. These values are subject to a variation for different heights of the antenna above ground, or may be altered by the presence of other wires in the vicinity of the antenna. A 500 ohm feeder can be built with two No. 12 wires, spaced 4 inches apart, with standard low-loss separators. The end resistance of this antenna is approximately 2,200 ohms on the fundamental frequency of operation, 1,500 ohms on the second harmonic, 1,300 ohms on the fourth harmonic, and 1,200 ohms on the eighth harmonic.

A typical antenna which is resonant at 7, 14.3, 29.1, and 58.8 mc. has a flat-top wire 89 feet long with 4 or 6 inch spacing at the center. The open-ended stub would be 22¼ ft. long and this stub should be pulled away clear of the non-resonant feeder, as illustrated in one of the sketches. Each half of the flat-top portion is 44.5 feet long, which makes each wire in the antenna 66 2/3 ft. long. This corresponds to a half-wave at 180° in the 40 meter band at 7 mc.



RESONANT AT 7, 14.3, 29.1, 58.8 MC.

Thus it can be seen that the antenna is resonant on the fundamental frequency, and in each of the high-frequency amateur bands which fall into harmonic relation with respect to the fundamental frequency. The resonant frequency is not exactly twice the fundamental frequency because of the end effects of the antenna wires. Fortunately, this antenna has a relatively high radiation resistance at the current loops, ranging from approximately 80 ohms up to 150 ohms in the different bands of operation, and this results in an antenna which can be used over the entire portion of each amateur band without changing the stub length or length of the flat-top.



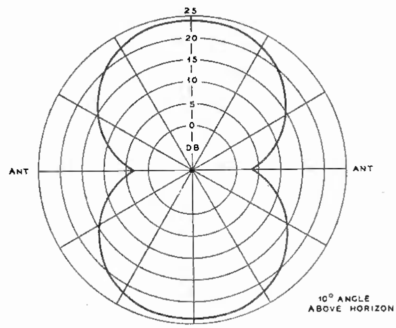
RESONANT AT 14.2, 29.0, 59.0 MC.

Another antenna suitable for 20, 10 and 5 meter operation which requires less space is also illustrated. It has two flat-top wires of 22 ft. each with an 11-ft. stub. An 80 meter antenna suitable for operation in the 80, 40, 20 and 10 meter bands, would have each half of its flat-top 89 feet long with a 44.5-ft. stub.

Gain and Directional Properties

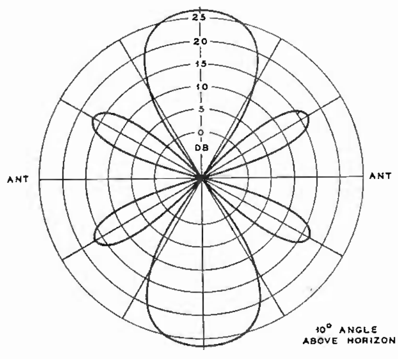
THIS antenna has more gain on the fundamental frequency than an ordinary half-wave doublet, since the high current portion of the antenna is effectively radiating in more than just a single half-wave section. Two current loops appear along the top of the antenna, with the result that the antenna has a gain of at least 1-db on the fundamental frequency. The gain in the direction of the major lobes for harmonic operation is at least 3-db over that obtained from a half-wave antenna; this effectively doubles the output of the transmitter.

The radiation patterns of this antenna are shown for operation on the fundamental, second and fourth harmonics. These curves are plotted in terms of db units, which tends to emphasize the minor lobes with respect to the main lobes. The curves are plotted for the effective radiation at an angle 10° above the horizon. From these polar diagrams it can be seen that the antenna radiates broadside for fundamental and second harmonic operation, and tends to become an end-fire antenna at the fourth harmonic, and even more so on the 8th harmonic. The four main lobes of radiation



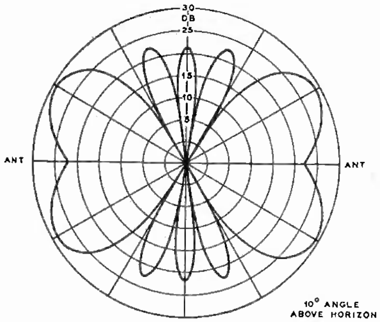
MULTIPLE BAND ANTENNA - FUNDAMENTAL

on the 4th harmonic are approximately 30° from the direction of the antenna wire. On the fundamental and second harmonic the main lobes are at 90° with respect to the antenna wire. At higher vertical angles above the horizon the radiation in the direction of the antenna wire is greater, and the antenna is less directional.



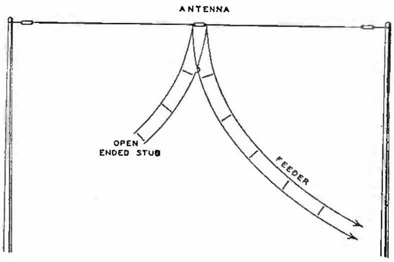
MULTIPLE BAND ANTENNA - 2ND HARMONIC

It is desirable to have the antenna from 50 to 70 feet above ground. The same rules that apply to any half-wave antenna likewise hold with respect to this antenna, insofar as its actual construction is concerned. The antenna wires proper can be hard-



MULTIPLE BAND ANTENNA - 4TH HARMONIC

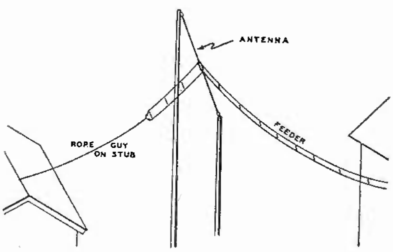
drawn No. 12 for most installations. Copper-clad steel wire, or even galvanized iron wire, will permit a more rigid form of suspension without danger of stretching in the flat-top portion of the antenna. The open-ended stub and feeder weight is suspended from the center of the antenna, which will



cause some sag, but this has no apparent effect upon the operation of the antenna, provided this sag does not exceed 7 to 8 ft. in a 90-foot suspension.

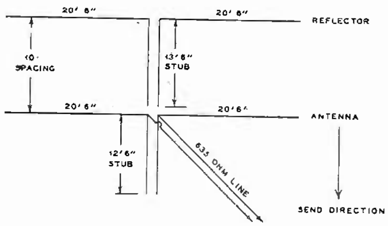
Beam Antenna

A 10 and 20 meter high-gain beam antenna with a fairly high radiation resistance can be constructed as shown in the last three sketches. The radiation resistance at a current loop on the fundamental frequency in the 20 meter band is approximately 40



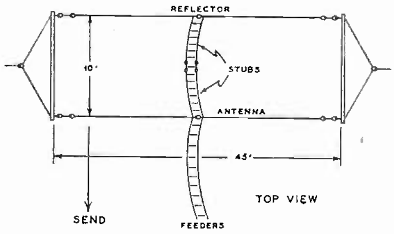
ohms, which is from two to three times as high as that of an ordinary close-spaced two-element rotary antenna. The radiation resistance at the current loops for operation on the second harmonic in the 10 meter band is approximately 135 ohms. These high values of radiation resistance mean that the antenna is not sharply resonant in spite of its high gain, and can be used over the entire 20 and 10 meter bands. The antenna is uni-directional and has a gain of approximately 5-db on 20 meters and 7-db in the 10 meter band.

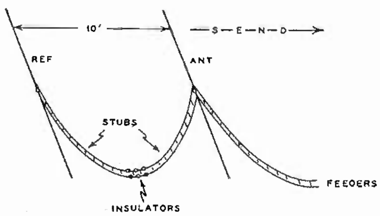
Another advantage of the high radiation resistance is that the end impedance is low enough so that ordinary wire and insulator construction is suitable, such as illustrated in the sketches. The end resistance of close-spaced beam antenans is so much higher that rods are generally used in order to avoid losses in insulators at the point of maximum voltage.



10 & 20λ BEAM-GAIN 7 & 5 DB RESPECTIVELY

This beam antenna has a relatively broad-heart-shaped radiation pattern and can be used to advantage where the expense of a three or four element close-spaced rotary beam is prohibitive. The two open-ended stubs in this antenna are tied together through several insulators merely for a mechanical reason in order to remove the stubs from the two-wire line.



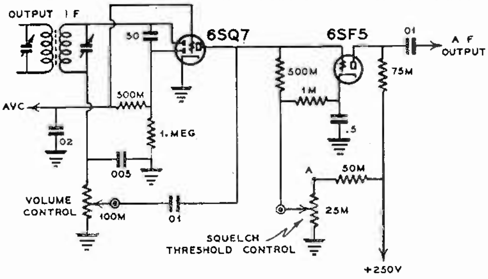


END VIEW

A 600 ohm line will be suitable for use with this beam antenna. Either No. 16 or

(Continued on page 71)

A Practical Squelch Circuit



SQUELCH CIRCUIT

*By Paul O'Connor**

THERE are numerous squelch control circuits and almost all of them operate by using the pre-determined carrier signal level to trigger an audio tube which has been biased beyond cut-off, the extent of which determines the signal voltage required before the audio system will go into operation. The circuit to be described works on this principle; the components have been chosen to provide a wide range of adjustment, as well as almost fool-proof operation. The first receiver built with this circuit was put into operation on June 5 of this year and has been on a 24-hour-day schedule ever since, except for time-out for routine service checks of the entire receiver.

When the receiver was first put into operation, it was tested in the noisiest spots with the threshold control set beyond the noise level. At no time did the squelch fail to operate when the transmitter came on the air. In one spot the noise level, riding in on the carrier, was so bad that part of the transmission was unintelligible. As soon as the transmitter went off, the receiver was silent.

The circuit is shown with type 6SQ7 and 6SF5 tubes; however, any equivalent types will be suitable. High-mu tubes were chosen to obtain better sensitivity and wider operating range.

The 6SQ7 serves as the second detector, AVC, and squelch control. The grid of the triode section is operated at zero bias, except for that voltage developed across the AVC load resistor due to the carrier input. Since control action is obtained from the AVC, it is desirable to design the AVC networks to have a small time constant, otherwise part of a transmission may take place before the squelch goes into operation, which would be the case if an appreciable time delay existed.

One of the diode plates is used for AVC and the other to supply the audio signal to the audio tube. Since the plate of the 6SQ7 triode and the grid of the 6SF5 are connected together, oscillation would occur if the grids of the two tubes were fed from a common circuit.

The type 6SF5 audio stage is provided with normal bias by means of the cathode resistor. Additional bias, sufficient to go well beyond cut-off, is obtained by the adjustment of the threshold control, which is a part of a voltage divider, the other part being the 50,000-ohm resistor. About 80 volts of bias is the maximum to be obtained. As the arm of the threshold control is moved toward the terminal "A," a positive voltage is impressed on the plate of the triode section of 6SQ7. Since this triode is operated at zero bias, plate current begins to flow. The flow of current through the 0.5-megohm resistor, which is common to both the 6SQ7 plate and the 6SF5 grid, produces a voltage drop which appears at the grid of the 6SF5 as additional negative bias. As the threshold control is advanced, the bias on the 6SF5 goes more beyond cut-off.

Assume that a signal is received and has an intensity sufficient to produce a voltage of 6 at the AVC terminal. The received signal may be either a carrier or one produced by high interference voltages. If this 6-volt signal is high enough to bias the triode section of the 6SQ7 to a point where this tube no longer draws current, or to approximately cut-off, the 6SF5 tube will be biased to normal operation, since there is no longer a voltage drop through the grid resistor. Under these conditions, the audio component of the voltage developed across the volume control will be amplified in the 6SF5 in the normal manner. If, however, the 6-volt signal permits sufficient current to flow in the plate circuit of the 6SQ7 to

(Continued on page 66)

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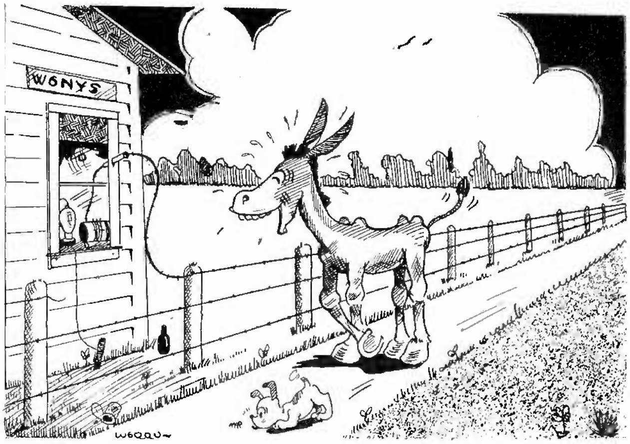
* Chief Engineer, J. W. Miller Co.

The R9-Plus Mile-Long Antenna Which Has Broken DX Records



EDITOR'S NOTE: This is one of the strangest stories yet published in an amateur radio magazine, yet it is not fiction . . . it is factual. Joseph Pierce, W6NYS, is the author of this article. Just a year ago, when amateur station W6USA was running full blast at the Golden Gate International Exposition on Treasure Island, the operators were repeatedly impressed with the unusual signal strength of a radiotelephone station operating on the 20-meter band. So strong were the signals that they were at first believed to be those from a commercial station, and many times the W6USA operators swung quickly to another portion of the band, not wanting to be annoyed with the QRM. Soon they heard this loud signal calling W6USA, and to the amazement of the operator the R9 blast signed the call of W6NYS. Later the signals were reported extremely strong in the Hawaiian Islands, and in numerous other locations. W6USA and one Hawaiian station reported W6NYS the strongest 'phone on the band. "That man must be using a few of those Kalifornia Kilowatts," they mused; they didn't bother to ask what power input was used at W6NYS. Neither did Joe Pierce proffer information on his power. It had long been taken for granted by him that R9 reports should be the rule, because the antenna was the secret of his success. So, then, let Joe Pierce tell you about his high power antenna and his low power transmitter.

THERE are more than 7,000 types of antennas and ten times as many feeder systems. I know, because I checked them in the antenna books, handbooks, catalogs, magazine articles, and from information exchanged over the air. I wanted an antenna, and I wanted a good one. To install 7,000 antennas, in order to find the one which would give best results, required a bit more time than I cared to waste. Every writer and amateur says his antenna is best, but I have one that beats them all. My antenna is located *"On the Road to the Nut House,"* and not literally, either, because the State Institution for the feeble minded, and for some of the hams who are reading this article, or those who will go crazy after they have read it, is pretty close to my QTH.

I devoted much time to the study of antennas. The things interest me. I learned a lot about putting holes in the air, and digging holes in the ground to keep the poles in the air, and how to plant ground wires and wash boilers to keep the earth moist.

I experimented with the twisted doublet, and the untwisted kind, also with the automatically expanding beam antenna and the signal squirters which operate on the principle of a lawn sprinkler. Some antenna experts maintain that an antenna should stick up straight, others insist they should lie down flat, and some want 'em to be twisted in the form of a snake, or a downright lazy "H." Bassett wants his antennas built so they can twirl around a full 360 degrees, then turn back in the other direction again. Johnson goes far down the alphabet, stops at "Q," and selects this letter for the name of his antenna system. Marconi steadfastly maintained that a single wire will do the trick. So, with the aid of my Chinese slide-rule and a streamlined radiation pattern taken from the front cover of the Police Gazette, I called a council of war among the livestock on my ranch and we put our heads together and began our calculations. Some of the best suggestions came from my pet donkey, as I will relate a little later on. Simple arithmetic soon provided us with the startling fact that it would take the average amateur as long as seven hundred years to try out all of the antennas described in the radio press during the last 12 months. Feeding my antenna books and literature to my goat proved to be a logical solution. My trouble started when I milked the goat; the thing was loaded with end-fire radiation.

Having disposed of every bit of literature on sky hooks, I proceeded to do what Marconi did—I strung up a piece of galvanized wire to a nearby tree, and put my 807 transmitter on the air. First ham I contacted told me I was coming in pretty good, and he inquired about my antenna. I told him it was a single length of wire, about a quarter of a wavemeter long. He told me that this was FB, OM, but he had a suggestion to offer—and to this amateur I owe a lasting debt of gratitude. He informed me that the longer the antenna wire the better, no matter the frequency of operation of the transmitter. He was dead sure that a long-wire antenna was the thing to use, on any band, because he had tried all of the antennas in the book, up to and including page 1407, and the single-wire variety proved best of all. My worries began when I tried to find a place to hang the far end of a long-wire antenna. There was nothing in sight except thin air, and that's not a very good substitute for an antenna mast. Then I cast my eye upon what later proved to be the secret of my success—a barbed-wire fence, five thousand feet long, about four feet above ground. This type of antenna had never been discussed in books, so I decided to invent one of my own. It's the only antenna the experts overlooked.

At first I was fearful that this 5,000-foot "antenna" might terminate in a neighbor's chicken coop, or in another place where the r-f at the far end could electrocute someone or something. Having only one life to give to amateur radio, I took a chance and connected the output from the 807 final amplifier to this barbed-wire antenna. Should the long limb of the law eventually reach out and ensnarl me, I could plead insanity and be acquitted by reason thereof. I sat down at the key, threw out my chest, and sneakingly called CQ. I worked VP6YB with this antenna in 1937, using 7 watts input on 10 meters. At that time I had a 6L6 in the final, but now I have gone to high power with an 807. The date of that VP6 contact was December 27, 1937, the time 2043 GMT.

Next came contacts with K6KQK, K7ENA and scores of U.S.A. amateurs.

This long-wire antenna is still in opera-

TOP—W6NYR (left), W6NYS (right), with radio blood-hound in center. The hound is the station mascot, ever on the alert for "antenna tappers."

CENTER—The shack at W6NYS. Note the gigantic meters, the large number of QSL cards on the wall, the modernistic operating table and, above all, the high-power transmitter with 807 in the final.

LOWER—Exterior view of W6NYS's mansion. The OM himself is seen gunning for power leaks.

(Continued on Page 68)

Technical Questions *and* Answers

Question: Why is an end-loaded Marconi antenna better than a base-loaded antenna of the same type?

Answer: The end-loaded antenna with a lumped capacity and inductance at the top end has a radiation resistance which may be several times as high as that of a short base-loaded antenna. The ground resistance loss will be a smaller portion of the total resistance of the antenna. The useful radiation resistance, which represents useful radiated power, will thus be a greater portion of the total resistance and the efficiency of the antenna will be improved greatly. The current maximum in the antenna is raised up to a useful portion of the radiating structure, rather than being confined to a loading coil at the base of the antenna.

* * *

Question: Why does the grid current in the final amplifier drop when plate voltage is turned on and the amplifier coupled to an antenna?

Answer: The decrease of d.c. grid current is due to an increase of grid impedance under conditions of load. Measurements indicate that it may increase from 50 to 100 per cent. The decrease of grid current is not due to degeneration in the r-f amplifier, as is often believed. No drop generally indicated, or possibly the presence of parasitic oscillations, which might cause an increase of grid current.

* * *

Question: Why does a folded dipole antenna have a greater radiation resistance than a single wire half-wave antenna?

Answer: The power input to either antenna is the same. For a two-wire dipole the currents in each wire are in phase and equal to each other. This current will be one-half of that of a single-wire dipole, or half-wave antenna. Since the radiated power can be expressed as I^2R, having the current will increase the radiation resistance of *R* for the folded dipole system by practically 4. The apparent radiation resistance is four times as high and the impedance at the ends of the two-wire antenna will be decreased by a like amount. For a certain height above ground a single-wire dipole may have a radiation resistance of 70 ohms, a two-wire folded dipole 4 times this value, or 280 ohms, and a three-wire folded dipole an apparent radiation resistance 9 times this value, or approximately 630 ohms.

* * *

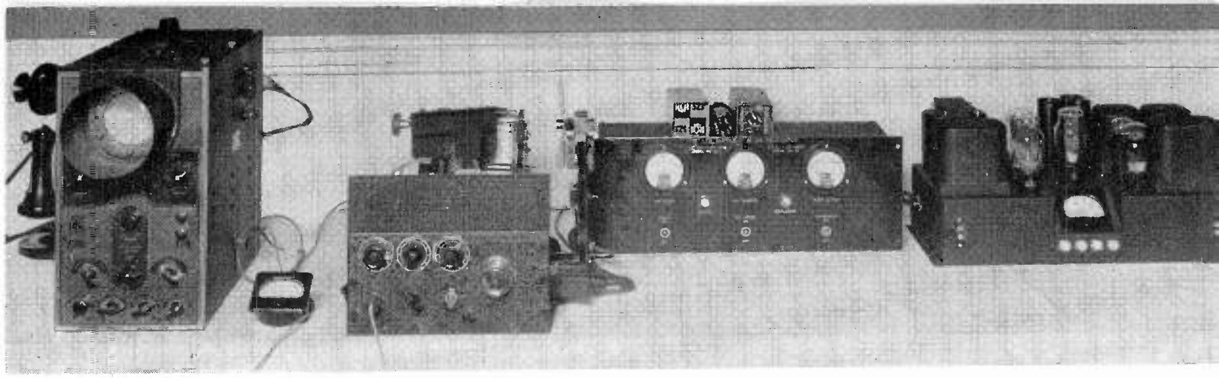
Question: I have often heard of the "loading effect" of a diode on its tuned circuit. How can this effect be calculated?

Answer: A diode tube acts as a high resistance shunt across the tuned circuit; this reduces the circuit Q and parallel impedance of the circuit. The equivalent series resistance of a high resistance connected in shunt with a tuned circuit can be calculated from the formula:

$$R_1 = \frac{1}{R_2 \omega^2 C^2}$$

where R_1 is the equivalent series resistance, R_2 is the shunt resistance.

The impedance of a parallel tuned circuit is equal to $Z = \frac{L}{RC}$ where *R* is the total series r-f resistance of the tuned circuit. An increase of this resistance will cause reduction of the parallel impedance Z. A reduction of Z causes a loss in current selectivity and voltage gain. The peak current is roughly twice the d.c. diode current, and the a.c. peak voltage is slightly greater than the rectified d.c. voltage built up across the external diode resistor. The AVC voltage, and a-f voltages built up across this external diode resistor, are used to control the gain of the r-f amplifier and to supply audio frequency to the a-f amplifier. The diode impedance is approximately equal to one-half of the d.c. diode resistance. For example, if the diode resistor has a value of 250,000 ohms, the diode impedance during normal operation will be approximately one-half this value, or 125,000 ohms. The equivalent series resistance introduced into the tuned circuit by this shunt diode impedance can be calculated from one of the preceding formulas. This series resistance should be added to the series resistance of the tuned circuit. If this resistance happens to be equal to the normal tuned circuit resistance, the parallel impedance of the tuned circuit will be reduced by one-half.



The Engineering Forum

Conducted by **F. D. Wells**

F. D. Wells

• *The editor of the Engineering Forum acknowledges and appreciates the cooperation extended by others in the radio fraternity in the compilation of material for this department. A number of excellent suggestions have been received and more are promised for our next issue. The reader is again reminded that each Item is numbered in consecutive order and further information on a particular Item should include the proper number, as listed in the text.*

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The Following Item Was Submitted by Ohmite Mfg. Co.

LINK coupling between tuned circuits is widely used in transmitter construction and offers several advantages, the most important perhaps being that the coils may be separated by quite a distance. The new LC-2 link control is a convenient means of regulating the transfer of r-f energy through the link or lower impedance line, thereby eliminating swinging coupling coils and their mechanical controls. The use of fixed link coupling coils makes possible a more compact layout and simplified construction.

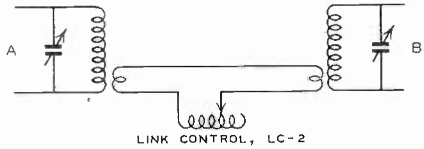


FIG. 1

The basic circuit is shown in Fig. 1. It is desired to transfer r-f energy from *A* to *B*. Coupling between the tuned circuits is by means of th link line. The link coupling turns should be so arranged that slightly greater than optimum coupling is realized without LC-2 in the circuit. This means 1 to 3 turns around each coil, as usually found on manufactured units, will suffice in most instances. As additional inductance is introduced into the link circuit by means of LC-2, the coupling effect *A* and *B* is reduced. Thus by adjustment of the link control proper loading by circuit *B* is accomplished.

Another hookup giving good results, especially at high power, is that shown in Fig. 2. Here the link control is placed in parallel

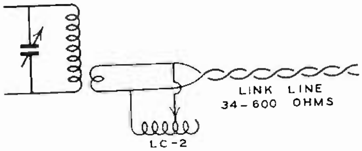


FIG. 2

with the line, the greatest transfer of energy taking place with all of LC-2 in the circuit. This circuit gives good coupling control on the lower impedance lines such as 34 or 73 ohms often used to feed a beam antenna.

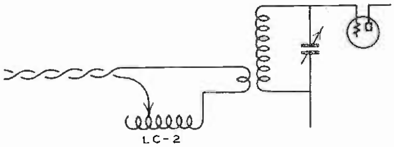


FIG. 3

If desired, the link control may be connected at the load end as shown in Fig. 3. Since the shaft of this unit is insulated from the moving arm it is permissible as well as convenient to mount the control directly on a metal panel. In case the mounting is to be on a chassis, a simple metal bracket may be employed. Connections should be made to the two right hand terminals, looking at the LC-2 from the wire side and having the terminals down.

Additional applications of this new control will suggest themselves, both in the transmitter and receiver field. For example, consider Fig. 4. Here we find the unit series

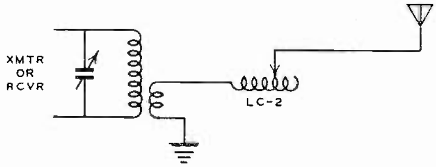


FIG. 4

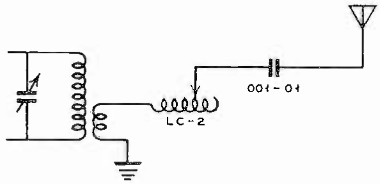


FIG. 5

connected in the antenna circuit, acting as a loading inductance, so as to resonate the antenna system to the desired **frequency. In** this manner, short lengths of wire may be used on transmitters while an increase in signal strength can be realized on reception. Should the antenna be of such a length that resonance can not be reached **by adjustment** of LC-2, try inserting a 0.001 to 0.01 **fixed** condenser in series to electrically reduce the antenna length somewhat.

* * *

No. 5—Actual Working Conditions Essential in Condenser Tests

The Aerovox engineers have submitted the following interesting matter for publication:

UNLESS service instruments approximate actual working conditions in condenser testing and checking, the results may be questionable. In condenser checkers, for instance, certain low-priced instruments check condensers at 60 cycles, in the absence of the oscillator found in the better-grade checkers. Obviously, a 60-cycle measurement is not at all the same thing as that attained at a radio frequency corresponding to that of actual working conditions for the condenser. Also, some checkers require the condenser to be disconnected from its circuit for the checkup. Here again, this is not the same thing as being able to check or test the condenser while actually connected in its circuit, which was the original idea behind the L-C Checker.

When it comes to capacity bridges, there are certain handicaps experienced with the cheaper models. For instance, if electrolytic condensers are measured on a bridge supplied with an AC voltage, they will be seriously damaged in short order. It is for such reason that the better grade capacity bridges are provided with a rectifier and power pack, for converting the line AC into suitable DC or polarized voltage. Also, a wide range of polarized voltages can be applied, making for the most accurate measurements based on simulated working conditions.

Such differences in operation should be borne in mind when considering bridge and checker equipment. There is a greater difference in characteristics and operation than there is in the prices of such instruments.

* * *

No. 6—A Means of Reading Plate and Grid Current Separately in the Cathode Circuit

IT IS common practice to connect a meter into the high-voltage lead of a transmitter circuit in order to read plate current only. This is a rather undesirable point of connection for a meter because the insulation of the meter case is often insufficient to prevent break-down between the case and the metal panel on which the meter is mounted. Furthermore, the leads running to the meter call for heavily insulated wire, which is difficult to handle and high in cost. The writer's attention was recently directed to a typical amateur's complaint. It was impossible to throw the transmitter switch without blowing fuses, yet there was no evidence of a short-circuit in any portion of the transmitter. It was mere good fortune that the amateur detected an arc-over from the metal ring of the meter to the panel upon which the meter was mounted. Like many other amateurs, he objected to the commonly accepted practice of connecting a meter into the cathode circuit, because by this means both grid and plate current would be read on the meter, and hence grid current must be subtracted from the actual reading of the meter in order to determine the correct value of plate current. In order to read only the true value of plate current on a meter connected into the cathode circuit, the grid meter must be returned to the junction point of the cathode, also to the meter in the cathode circuit, rather than to ground, as shown in Fig. 6a.

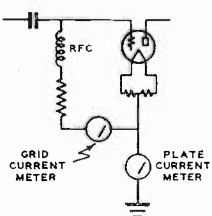


Fig. 6a

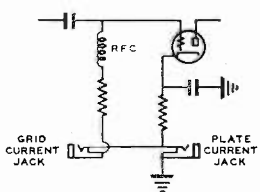


Fig. 6b

Economy sometimes demands that a single meter be employed. Plate current can then be accurately checked by plugging the meter into the proper jack, as shown in Fig. 6b.

The grid circuit jack is returned to the cathode at the tube socket, rather than to ground. The jacks in the circuit of Fig. 6b must be insulated from ground, by means of the insulated washers which are usually fitted to the jacks. If the circuit calls for a cathode bias resistor, it would be connected at the junction point of the two jacks and cathode, as the circuit shows. Where filament-type tubes are employed the filament center-tap takes the place of the cathode, either from the transformer center-tap or from a resistor connected across the filament terminals at the tube socket.

* * *

No. 7—Reducing Power Supply Ripple

SOMETIMES a power supply develops too much ripple after it is connected into the circuit, and it is often found that a very slight reduction of ripple will make the unit more suitable for the purpose for which it was designed. In practically every instance this can be accomplished by connecting a by-pass condenser across the filter choke. If the power supply operates with condenser input, the by-pass condenser must be connected across the filter choke. If the power supply operates with choke input, this method is applicable only to the second, or filter, choke. In no case should a condenser be connected across the input choke.

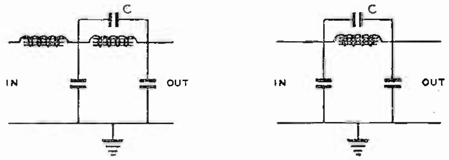


Fig. 7—Showing how by-pass condenser *C* is connected into the circuit, either for choke or condenser-input.

The value of the by-pass condenser is determined by experiment, and the following example serves as a guide: A 400-volt power supply with condenser input and capable of carrying 200-ma. was found to have a ripple potential of 4 volts A.C. This value was read on a high-resistance A.C. meter in series with a blocking condenser. The choke was rated at 20 henrys at 250-ma. A condenser of 0.25 mfd. was found to be of the optimum value required and the ripple voltage at the output of the filter was reduced from 4 volts down to 1 volt, or a 4-to-1 reduction in hum level. This application may prove of great value to those troubled with excessive hum on the carrier of a transmitter, or in the output of a public address system, etc.

* * *

No. 8—Two Cures for BCL Interference

LIKE the poor, the *BCL* will always be with us. If all complaints against amateurs were lumped together, it is safe to assume that 50 per cent would fall into two classifications: (1) A.C.-D.C. midget radios, of which there are already too many in the $5.00 to $9.00 price range, and (2) the obsolete receiver still prized by the antique hunter, and which utilizes type 26 and 27 tubes and grid-leak detection. The fact that these receivers have been obsolete for many years does not lessen their value to the present owners. The cure suggested here is not infallible, yet it has proved meritorious in many instances. In both cases it is assumed that the interference enters the receiver at the second detector tube. Unfortunately, in the case of the A.C.-D.C. set, the stages preceding the second detector cannot be removed one by one in order to establish the point at which the interference enters, since the filaments are in series and the removal of one tube will make the receiver inoperative. In the case of antiquated sets the tubes should be removed one at a time, beginning with the first r-f stage, and it will usually be found that the signal from the amateur transmitter will persist in the receiver until the type 27 detector tube is removed.

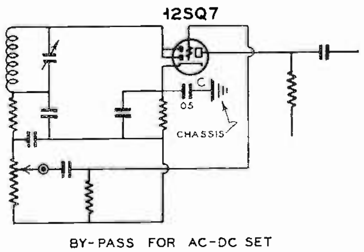


Fig. 8—Method of connecting by-pass condenser *C* in A.C.-D.C. receiver circuits.

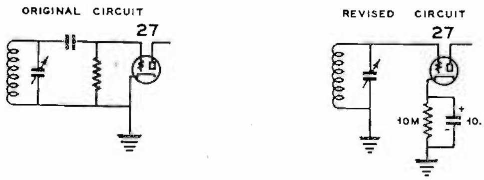
The cure: Most modern A.C.-D.C. sets utilize a 12SQ7 as a second detector. In four cases brought to the attention of the writer a cure was affected when by-passing the cathode of the 12SQ7 back to chassis with a 0.05-μf. condenser. It is suggested that several different spots on the chassis be chosen for the ground point, since an optimum point can often be located in this manner. One problem was solved where the five-tube A.C.-D.C. receiver (without r-f

(Continued on page 62)

ENGINEERING FORUM

(Continued from page 61)

stage) was operated not more than 150 feet from a 3-element beam, the input to the final amplifier being 500 watts (the input to the BCL antenna 200 watts.—*Ed.*). The only effective cure for this receiver with its type 27 tube detector was to completely change the detector circuit from grid-leak to power detection. This is accomplished by removing the grid-leak (which normally has a value of from 1- to 5-megohms), and connecting a jumper across the grid condenser. The cathode must then be freed from its circuit, and connected to ground through a 10,000-ohm resistor and by-passed with a 10-mfd. condenser.



GRID LEAK DETECTOR CONVERTED TO POWER DETECTOR

As additional BCL interference problems reach the editor of this Department, they will be treated in these columns. Send your suggestions and problems to him now.

Condensing The Portable Station

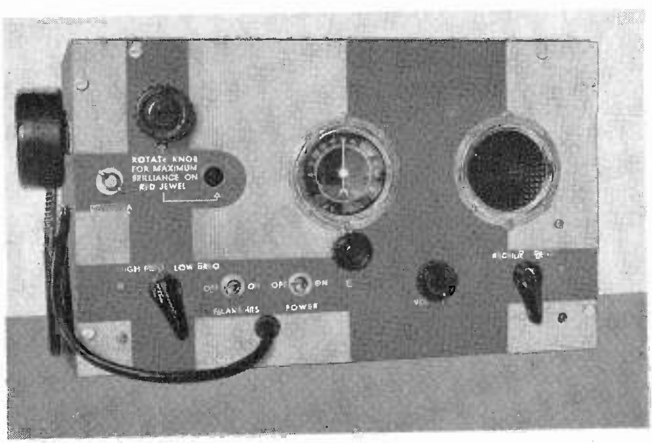
The demand for simple, self-contained emergency transmitters is at an all-time high. Here is a radiotelephone transmitter and receiver of especial interest to the amateur; it is complete from Vibrapack power supply to antenna coupling unit.

By The Technical Staff

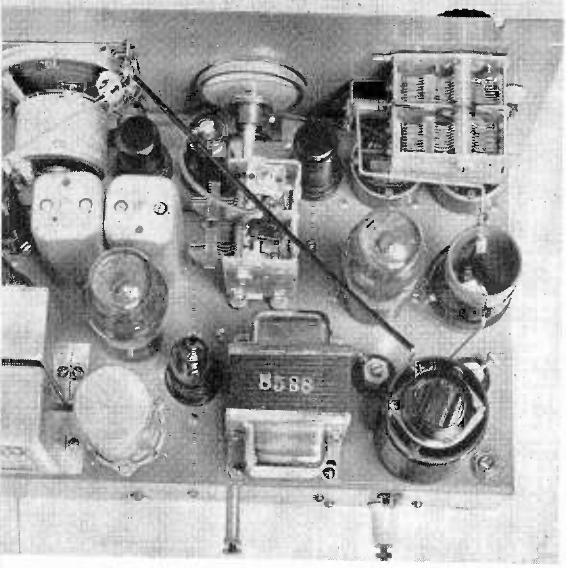
PORTABLE equipment for emergency service, or for any one of a dozen other applications, can be designed so as to be extremely compact and self-contained. Weight, although a factor, is still not of such importance as to limit the power of the transmitter to fractions of a watt, nor is it so vital that the receiver cannot possess excellent sensitivity. After all, portable operation in itself assumes more ideal operating conditions, but in most instances the conditions for good antennas are totally lacking. Portable operation demands storage battery operation, and precludes the use of dry "A" or "B" units, since transmitters powered from the latter are decidedly limited in output.

The need for low-frequency operation for portable service is fairly well established. UHF for hilly terrain is not satisfactory, and does not take advantage of the skips that occasionally make long transmission possible, even with low power. While it is possible to design equipment that will be capable of working on several bands, such equipment is apt to be complicated. Certainly there will be an increase of both weight and physical size, and introduce further problems in antenna loading. Building a good portable unit for even two bands, 80 and 160 meters, presents enough technical and mechanical problems to keep the average amateur busy. For this type of unit, the amateur can well borrow some ideas from his commercial friends who make the things for a living. Units of this type are in general use throughout the country on small craft of all types, mainly power boats and yachts. Here the power supply is generally a 6-volt storage battery, with none-too-adequate charging facilities. Antenna possibilities are definitely limited. This latter subject is treated from a new angle elsewhere in this issue by W. J. Stancil.

We present here a small 10-watt transmitter, in combination with a suitable superheterodyne receiver and 6-volt vibrator power supply. General appearance of this unit is well conveyed by the various photographs. Physical size of this particular job is 13 in. long, 8½ in. high, and 9 in. deep. We make no mystery of the fact that this unit is commercially designed and built. We justify this "commercialism" by the fact that the manufacturer of this unit definitely states that it is not made for amateur service, and specifically asks that his name remain anonymous. We were overcome by this magnanimity, until he mentioned that this was his old model, and since it is to be replaced by one entirely different, we were invited to tell all. Quite naturally, to minutely de-



Front view of emergency radiotelephone transmitter and receiver. This instrument is one of many of similar construction, long in service commercially, yet the circuit details are precisely the same as for amateur application. A small PM speaker and microphone are integral. Only an antenna connection and storage battery are needed in order to put the instrument into operation.



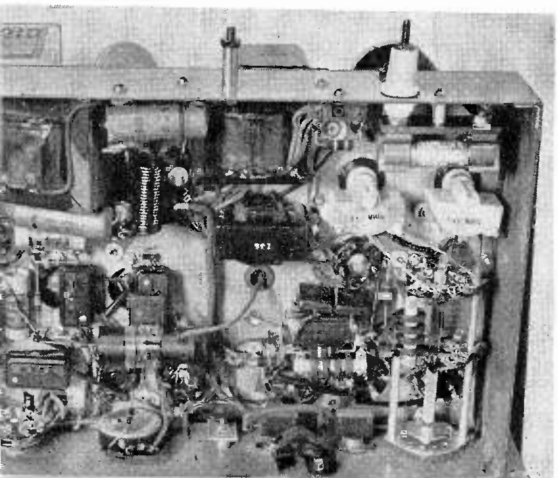
scribe this unit is quite impossible in the few pages that we can devote to the subject. We hope merely to touch on the highlights, particularly those which seem to offer something new.

The receiver is quite conventional. It departs mainly from standard practice in the use of a power-type second detector. AVC with this circuit is a bit impractical. Overloading is taken care of in the volume control. Over the distances normally worked, fading is not bad enough that AVC would warrant the extra stage and complexities its use demands. These little receivers are "hot." The combination 6V6G audio amplifier and modulator gives an audio wallop great enough to create quite a stir in the little loudspeaker on the panel.

The receiver can be made with a tuning ratio to cover both 160 and 80 meters, if a full-sized (365$\mu\mu$f per section) variable condenser is used. Naturally, band-spread will be non-existant, but this disadvantage can be tolerated in view of the freedom from band-switching or plug-in coils for band change.

Technical Considerations

THE send-receive switch consists of a single wafer type, such as used in receiver band switches, and has four poles, two positions. One pole is used to switch the antenna from receiver to transmitter; the second, to switch the B-plus from receiver to transmitter; the third switches the grid circuit of the 6V6G audio tube from the detector plate of the receiver to the microphone transformer; the fourth breaks the voice coil circuit of the speaker in the transmit position.



Since the 6V6G tube is used both as the audio amplifier for the receiver and modulator for the transmitter, the B-plus connection is permanently tied to the plate return. A combination modulation and speaker output transformer is used. It has one winding which is connected in series with the voltage feed to the final amplifier for purposes of modulation, and it has another winding to match the voice coil of the 3-inch p.m. speaker, which is fastened to the front panel. It is therefore essential that the voice coil of the speaker be disconnected during transmit periods, so that when the microphone is spoken into, the voice does not come into the speaker and cause audio feed-back.

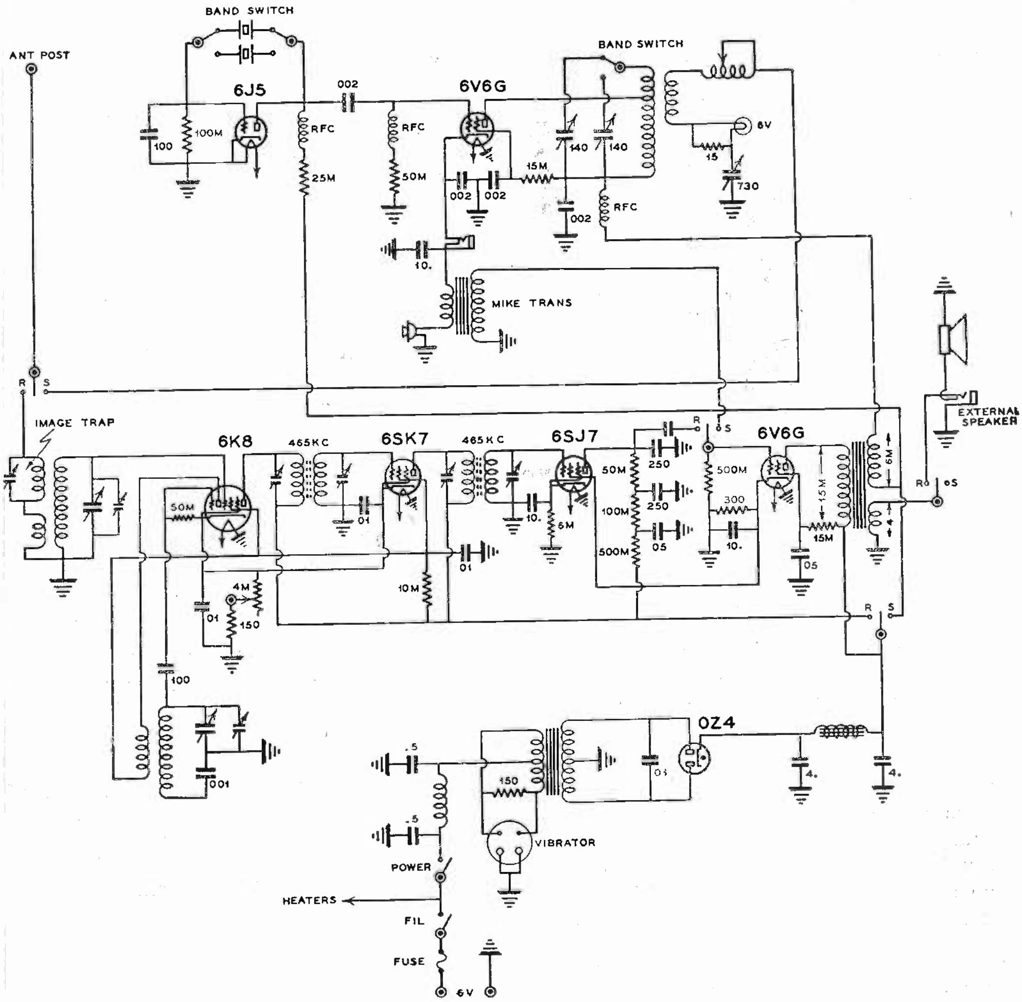
The cathode of the final amplifier goes to a metering jack, then through the microphone winding of the microphone transformer, and through the microphone to ground. The junction of the microphone transformer and the jack is heavily bypassed. The current from the final amplifier furnishes microphone current for the *Western Electric* F1 single-button carbon microphone.

The metering jack serves a dual purpose. It permits the operator to measure the final plate current while tuning-up the two bands, and provides c.w. transmission by the simple expedient of plugging-in a key.

140- or 150-$\mu\mu$f condensers will allow operation on both 160 and 80 meters, if care is taken in winding the final tank coil. After having been tuned to frequency, the condensers are locked into position by thumb screws, and operation on either band can be had merely by the flip of a switch. As a matter of fact, one crystal would suffice, since the 6V6G final amplifier doubles quite readily. On the other hand, the transmitter can be tuned-up for two frequencies in one band, either of which will be instantaneously available on the band switch.

The *Pierce* oscillator which drives the final amplifier has proven highly satisfactory. The crystal current is well within the limits prescribed for low-frequency crystals and is exceptionally non-critical.

The antenna network will permit operation into almost any length of wire, up to

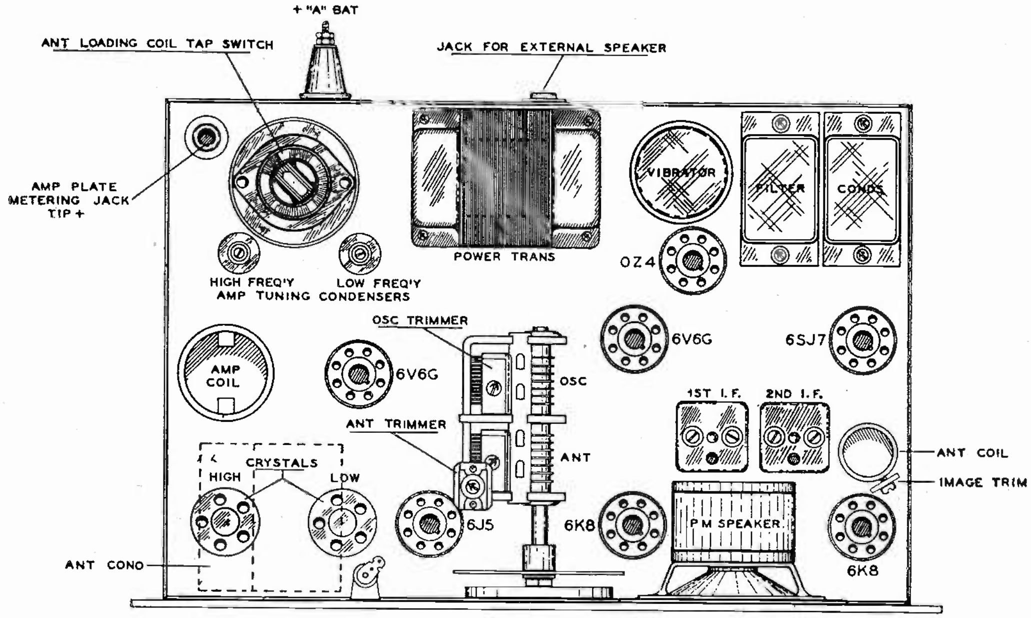


Complete circuit diagram of emergency portable transmitter-receiver. By winding the coils to cover one or more amateur bands, this instrument will fulfill every need of those interested in emergency communication over moderate distances.

three-eighths wave. It consists of a variable inductance and a variable condenser, both in series with a pick-up coil coupled to, and wound on, the final amplifier tank coil. Also in this circuit there is a 150-ma., 6-volt pilot lamp shunted by a 15-ohm resistor which serves as a resonance indicator.

The loading coil has a value of 50 to 60 micro-henries, about 40 turns of No. 16 enameled wire, closely wound on a two-inch form and tapped every 10 turns. By means of an *Amphenol* tap switch mounted directly on the coil, one-quarter, one-half, three-quarters, or all of the coil may be shorted-out at will. On the other hand, a blank position on the switch will permit the full inductance to be used. It might seem from this that only five different sets of antenna conditions are provided for. However, the condenser, a two-gang, 350$\mu\mu$f in parallel, has sufficient capacity to allow interpolation between the jumps in inductance given by the tap switch. Short lengths of wire may be loaded-up to a quarter-wave by use of the inductance, and lengths greater than a quarter-wave can be electrically shortened and loaded to a quarter-wave by the condenser. In the latter case, of course, most or all of the inductance will be shorted out.

The vibrator pack, which is integral with the unit, has an intermittent rating of 300 volts at 100-ma. However, in spite of this, no excess heat is caused by an hour's steady running at full load. The full load occurs



Parts layout for emergency transmitter-receiver. This diagram will aid the builder in the proper placement of components. Careful thought was given this design, and the prospective constructor is advised to adhere closely to this general arrangement.

only during transmit periods, hence the rating is ample. In compact equipment of this kind, vibrator hash in the receiver is not only likely to occur but usually does. Anyone undertaking to build something of this general description is urged to use the utmost care in grouping all components pertaining to the vibrator pack in one portion of the chassis, and as far from the receiver as possible. Much less trouble will be had from this source if the vibrator pack is built as a separate unit. *Mallory Vibra-packs* should be ideally suited to this purpose, since they are well-designed, carefully filtered and are definitiely reliable. Leads from the vibrator to the transmitter should be kept to an absolute minimum, and a 100-ohm, 1-watt resistor directly across the points of the vibrator will aid in the reduction of noise from the pack. With a full 6-volt input, the receiver drain is approximately 5 amperes; transmitter drain, 8 amperes.

As is the case of all equipment working into quarter-wave antennas, a good ground is of the utmost importance. In small boat installations, there is the specific advantage that the entire ocean is ordinarily available for a ground connection. In the case of operation on land, counterpoises are well worth a trial. Very often 50 to 60 feet of wire laid along the ground proves effective. One of these units was used in an amateur station just to see what results might be obtained. The antenna consisted of a loaded eighth-wave, and the ground was furnished by the water company via the house plumbing. Distances up to a thousand miles were contacted on phone without any great difficulty. This work was done on the 160-meter amateur band.

* * *

A PRACTICAL SQUELCH CIRCUIT

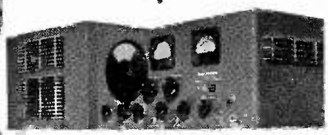
(Continued from page 55)

leave the grid of the 6SF5 biased beyond cut-off, the audio voltage from the volume control will not pass through the 6SF5, and no signal will be audible in the speaker.

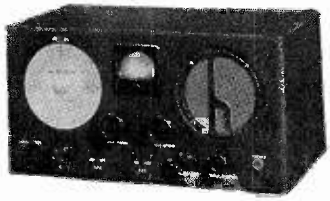
If a signal of 6 volts is required to permit operation of the audio amplifier, it can readily be seen that signal voltages of lower values will not trigger the squelch circuit, and thus will not be heard . Under some conditions, after the threshold control has been set to permit the desired signal to properly operate the squelch circuit, noise signals having an intensity about equal to the signal may periodically set off the squelch and intermittent noise pulses will be heard. Such conditions are not often encountered in commercial practice.

For top performance on all bands, buy me—Hallicrafters' latest and finest - the SX-28. Terms $12.15 a month. Write to W9ARA for information on me or any receiver.

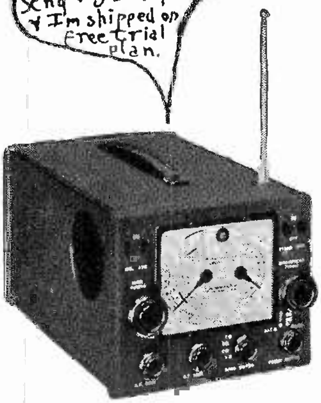
For top performance at medium cost, buy me, the SX-25. Terms only $7.03 a month. W9ARA gives you the best trade for your old set on any new one. Write him!



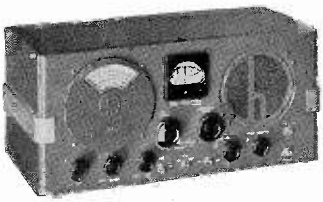
I'm S19R and a lot of radio for $29.50. Terms, $2.08 a month. Bob finances all terms himself, so you buy with less cost—no red tape—quicker delivery. Write Bob for details.



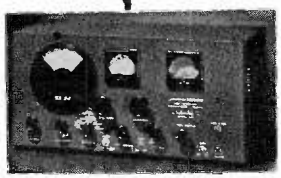
S-29 9-tube portable—that's me!—operating from 110V AC-DC or self-contained batteries. I tune 9-500 meters. Send $5.00 deposit & I'm shipped on free trial plan.



I'm SX-24, the 9-tuber with electrical bandspread and freq.-meter tuning from 43.5 to .54 MC., costing only $69.50. Try me or any other set on Bob's free trial plan.



I'm the 9-tube S20R, giving top performance at $49.50. When ordering me or any other set state whether you prefer shipment from W9ARA's world's largest stock or from factory.



My Pledge to the Amateurs

I sell all makes and models of receivers, xmtrs, parts. I want to help you get the best apparatus for your use and to see that you are 100% satisfied. I guarantee you can't buy for less or on better terms elsewhere. Write and tell me what you want and how you want everything handled. Bob Henry W9ARA

HENRY RADIO SHOP

BUTLER, MISSOURI

THE RQ-PLUS ANTENNA

(Continued from page 57)

tion, but I seldom mention the fact to anyone because they give me the HI HI, and I request that after this article appears in print, and all the amateurs know about my antenna, no further mention of it be made. I have recently added an E. C. Opian for frequency control, also a T40 final r-f amplifier, using the 807 as a driver. Although not shown in the photographs, because these were taken three years ago, I now have four receivers, an RCA-ACR, PR-10, RME and a Radiola 3, series of 1900. That's what it says on the nameplate of the latter, but the RCA people probable got the dates and serial numbers twisted. I am experimenting with 2,000 square feet of galvanized roofing on my hay barn, tuning the long barbed-wire antenna against the roof of the barn, and am also using it for receiving. I would like to know if you want to publish a book on this subject. I got better results from my own antenna than from any described in ham magazines, but I haven't read the antenna articles in next month's issues yet.

If I have overlooked some of the technical features of my antenna I hope the readers will ask for additional information. I would like to offer a little advice to those who try this mile-long barbed-wire fence antenna—make sure that you hang a red flag at the far end of the "system," so that some other ham won't hook his transmitter to that end of it.

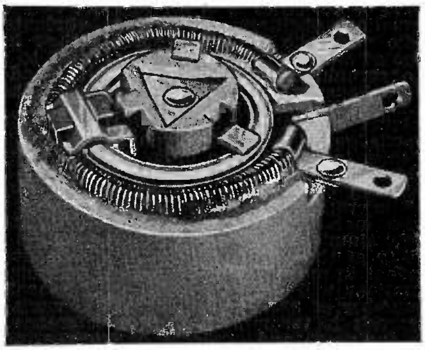
"I heard you say you had bugs in the rig."

New Products

New Power Rheostat Presents Novel Features

EXTREME sturdiness, both mechanically and electrically, characterize the new power rheostat just introduced by Clarostat Mfg. Co., Inc., of 285-7 N. Sixth St., Brooklyn, N. Y. The design for this control is said to be the net result of several years of engineering effort, including the building and scrapping of many models before evolving the final choice.

Selected resistance wire is wound on an insulated aluminum core. The resistance element is bent round, placed in the slot of the ceramic shell, and firmly imbedded in a cold-setting inorganic cement similar to that used for the well-known Clarostat Greenohm power resistors. This construction provides maximum heat conduction and dissipation from winding to special ceramic casing. No corrosion of the wire is possible, nor any weakening, since no high temperatures are required in setting the cold-setting cement used.



A graphited-copper contact shoe rides the brass third rail ring and the winding, with a positive, velvety sliding contact. The ingenious tripod-type rotor provides for a three-point support on the brass contact ring and the winding, against the concealed helical spring pressure, for the smooth, easy, non-binding rotation. The rotor is insulated from the metal shaft by a center ceramic insulator. The rheostat may be mounted in any position with regard to its terminals and knob rotation, by means of the adjustable locking pin and disc. For the present, only the 25-watt size is available, but larger sizes will follow shortly.

* * *

AN INGENIOUS method whereby a conventional cathode-ray oscillograph is employed as an indicator for determining the transit time of electrical switching equipment, such as relays and contactors, together with a graphical solution of the pattern obtained from the cathode-ray oscillograph, examples of the method and its extension to other problems, is the subject of the latest issue of the Du Mont Oscillographer. This paper is the first of the entries in the Du Mont Cathode-Ray Symposium and Prize Contest recently announced, and is representative of the cathode-ray application ideas being reported by contestants. A copy may be had by writing Allen B. Du Mont Labs., Inc., Passaic, N. J.

New Radio Handbook

RADIO HANDBOOK, Seventh Edition, published by Radio, Ltd., 1300 Kenwood Road, Santa Barbara, California. $1.60, Cloth Bound. (No paper-covered editions available). This well-known text for the radio amateur, designer and experimenter is now produced with a heavy, cloth cover. The new edition for 1941 has 608 pages. The text is by the editors of "RADIO." The major portion of the book has been re-written and a new type face is used. It is a well-indexed Handbook, printed on a durable grade of paper, and illustrated with hundreds of photographs and diagrams. An interesting and instructive chapter on Frequency Modulation is one of the features of this new book. UHF treatment is generous and, in many respects, entirely new. The Transmitter and Receiver Tube Tables occupy more than 40 pages, and they are the most complete and useful of any yet published. All the newer antenna systems are described. The chapter devoted to amateur license examination questions and answers is of particular interest and merit. Readers will appreciate the durability of the new binding, and the gold-embossed cover. It elevates the amateur's Handbook from the catalog class, and it will be a most welcomed addition to every radio man's library.

* * *

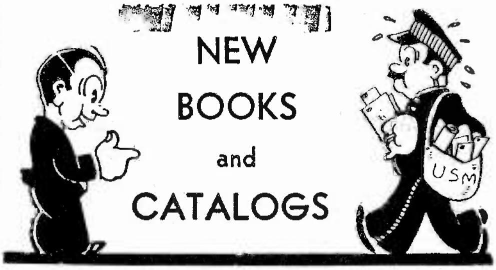
Amateurs in the DRAFT

THOSE who have become unduly alarmed over the number of radio amateurs who will be forced to abandon their activities because of military training should ponder these statistics: (1) There are approximately 50,000,000 males in the United States. (2) 16,000,000 have registered for a short period of military training. (3) 800,000 will be called for service each year, while another 800,000 will be discharged from training. (4) There are approximately 50,000 licensed radio amateurs in the U.S.A. Looking at the figures from the darkest angle, and giving the amateur no "breaks" of any kind from the standpoint of age, physical condition, occupation in essential industry or other good reasons for exemption, less than 1,000 will be called for training each year.

Judging from the growing number of new amateur licenses issued each year, the ratio of those called for training versus the number of newcomers into amateur radio looks like 1-to-10, or more. No cause for alarm. Furthermore, the thousands of young men now undergoing radio training in the various educational projects may bring an influx of new licensees into amateur radio of such proportions as to dwarf any previous yearly record.

Some of the better minds in the amateur field have estimated that within two years there will be almost a quarter-million licensed amateurs in the U.S.A. This estimate is entirely out-of-line. Our guess is that we will have a

(Continued on page 71)



Radio Operators' License Guide, by Wayne Miller, Consulting Communications Engineer. 200 pages. Heavy, durable paper cover; $3.00 per copy. This Guide contains over 1,250 acceptable answers to the new "Six Element" radio operator license examination questions as embodied in the Federal Communications Commission Study Guide. The author has had extensive radio engineering service in numerous broadcast and marine radio stations and has also served as design engineer for some of the larger American radio manufacturing plants. He was Chief Instructor of Wallace Radio Institute, Kansas City Radio School, Modern Radio Institute, and other educational institutions. His Guide is authentic and up-to-date. Every effort has been made to present the subject matter in sufficient detail to fulfill present-day requirements. It is carefully compiled, easy to understand and apply, and of inestimable value to all applicants for commercial radio operator license.

* * *

"Elements of Acoustical Engineering," by Harry F. Olson. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y. $6.00 per copy. This elaborate text on the principles of acoustics is of interest not only to the acoustical engineer but also to students and radio men who desire to increase their knowledge of sound reproduction as applied to radio, phonograph, motion pictures, public address, microphones, and sound measurements. The text was compiled from the subject matter of 30 lectures presented at Columbia University. A knowledge of elementary physics and electric circuits is essential in order to appreciate the subject matter contained in this book. The Chapters devoted to all types of loudspeakers and microphones will be of especial interest to radio men. The text is well illustrated with many simple diagrams which enhance the readability of the subject matter. For the advanced student in mathematics, the many formulas and equations will prove valuable for research into a number of branches of acoustical work. This textbook is recommended as a reference book for engineers and students of engineering and physics. The author treats his text in a practical manner. He is Director of Acoustic Research for R.C.A. Mfg. Co., Inc.

* * *

"TELEVISION ENGINEERING," by Donald G. Fink, Managing Editor, "Electronics" (Magazine). Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York City, N. Y. $5.00 per copy.

A new textbook to acquaint the radio engineer and student with the principles of television engineering. A knowledge of radio engineering is essential in order to understand and apply the subject matter in this book. Ten chapters of more than 500 pages total are devoted to the fundamental principles of television receivers, transmitters, image analysis and camera action, and television signal analysis based on present R.M.A. standards. The text can be readily understood by the average student or advanced radio man, since the mathematical treatment is not too complex in nature. In general, the material on television is presented in a very clear and complete manner, and is particularly useful to the man who seeks information on the technical side of television. The text is profusely illustrated with simple diagrams.

VIBRAPACK POWER SUPPLIES

(Continued from page 50)

nect to one leg of the filament, so that any ripple in the filament circuit results in an AC potential difference between the "hot" side of the filament and the grid. Also pulsations in emission occur since the small filaments do not have a large thermal lag. Uncorrected, these conditions may lead to excessive hum.

The simplest and most effective way of eliminating the trouble, although the least convenient, is to operate the filaments from a separate independent storage cell. However operation from the main storage battery, either by means of a series dropping resistor, or by tapping to a single cell is practical if low frequency filtering is provided for the filament supply circuit. This filtering can be provided with a low resistance iron core choke. For small sets the voice coil winding of a dynamic speaker output transformer can be used for the purpose. The choke only is usually adequate but if further filtering is desired a small 1000 mfd. low voltage condenser can be connected between the load side of the choke and the chassis. The choke, of course, would be placed in the "hot" filament lead that is "off-ground" in potential.

Conclusion

It is hoped that this article will illustrate to readers the value of the Vibrapack, its versatility and its ease of application for various services wherein power requirements range from a watt or two to the maximum of 60 watts.

* * *

JONES FOUR-BAND ANTENNA

(Continued from page 54)

No. 14 wire, spaced with 6-inch separators, can be used for the construction of the non-resonant line. The antenna flat-top portion should be made of heavier wire for mechanical reasons. This beam antenna does not have the same dimensions as the simple 20 meter antenna because of the presence of the parasitic reflector which changes the resistive component of the impedance along the antenna wire. The flat-top portions are each 20½ ft. long to the center and the antenna open stub is 12½ ft. long, whereas the reflector stub is approximately 13⅓ ft. long. The spacing is made 10 feet in order to produce an impedance of approximately 600 ohms at the termination of the transmission line.

AMATEURS IN THE DRAFT

(Continued from page 69)

25 per cent increase in our amateur fraternity, provided we do not engage in war. Viewing the situation from a war-like angle, it appears that the skilled men of amateur radio will remain on the air, because our government can ill-afford to be without the facilities and abilities of these experts. How many? Let's arrive at a round figure of 10,000. File this notation in your "radio hope chest," check it in 1942.

* * *

Military Activities of Radio Amateurs

From W8SRS we learn that W8UEY (ex-K5AC), formerly with the U. S. Army, has joined the naval reserve unit of Ohio. W8SRD of Youngstown, Ohio, and W8SBR of Cleveland are in the Ohio National Guard and will leave shortly for Camp Shelby. W8SZV of Steubenville, Ohio, is stationed at the Norfolk, Va., U.S.N. Training Base.

ENGINEERING APPLICATIONS

Hytron HY-61/807 and HY-69 Beam Tetrodes

R.F. Amplifiers, Buffers, Frequency Multipliers

• Class-C amplifiers are used exclusively for unmodulated R.F. amplifier applications, such as buffers, frequency multipliers (doublers, triplers, etc.), and as final amplifiers in CW transmitters. Choice of tubes depends on driving power available, number of stages in the transmitter, power output desired, and cost of tubes.

For ease of drive, the R.F. beams tetrodes are outstanding, and they have the further advantage that no neutralizing is required in well-designed stages. In its power class, the HY61/807 is the easiest of all tubes to drive; less than ¼-watt of driving power will provide a power output of approximately 37.5 watts when operating on the fundamental frequency. A circuit for this application is shown. As is the case with all R.F. amplifiers, it is desirable to adjust the excitation, bias, and screen voltage to those values which will provide optimum tube performance. These adjustments may be needed to take care of variations in "Q" of tank circuits, variations in L-to-C ratios, etc.

For somewhat higher power capability than can be secured from the HY61/807, there is the HY69. This tube has a 40-watt plate dissipation. It is suitable for many applications, and tests show it to be infinitely better for frequency multiplier applications than the HY61/807. Values for the HY69, both for a doubler and straight R.F. amplifier, are shown in the circuit. Like the HY61/807, the HY69 is fully shielded and requires no neutralizing. The maximum frequency of operation is 60 megacycles.

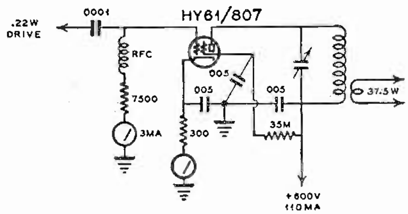
Triodes are without question the least expensive of all tubes in terms of power output, and because of their rugged and simple construction they can be driven to higher efficiencies than tetrodes and pentodes. However, they require many times the R.F. driving power of a beam-power tube or pentode, but such is generally inconsequential. The HY51A, which is a graphite-anode triode having a 65-watt plate dissipation, has a maximum allowable input rating of 175 watts as a neutralized R.F. amplifier. The circuit shown herewith gives constants suitable for the HY51A operated with 140 watts input and approximately 110 watts output. When used as a power doubler the input is reduced to 130 watts and an output of about 65 watts is obtainable. Use of the HY51A as a power doubler will often eliminate a buffer stage, because of the high power available.

(Note: All values are for continuous-service operation.)

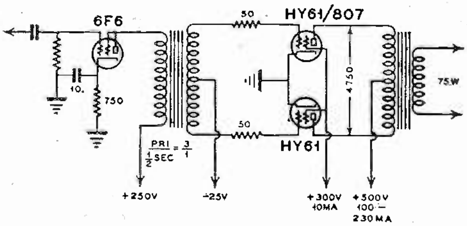
MODULATORS

• The choice of a modulator depends not only upon the power output required but also upon availability of driving power, bias and suitability of power supplies, chiefly from a standpoint of regulation. For high power outputs, triode-type tubes operated in class-B are, without question, most suitable. Class-B modulators are relatively high in efficiency, and they are not critical as to circuit components unless an attempt is made to secure the last drop of power from either the driver stage or the modulator itself. Shown on the facing page is the circuit for an HY51A 260-watt modulator. An HY-51Z can be substituted by merely eliminating the bias. Due to the extremely high mutual conductance of the HY51 series, a pair of 45's will provide sufficient power to drive them to full output.

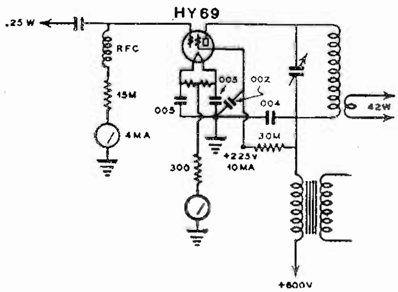
In the case of mobile type transmitters it is essential that circuits be simplified and bias requirement eliminated. The HY31Z, which is a high-mu twin triode, is ideally suited for mobile and portable work, since no bias is required. Furthermore, the HY31Z has an instant-heating thoriated-tungsten filament, which means that the filament can be "off" during stand-by periods, so as to decrease battery drain. While the HY31Z was designed spe-



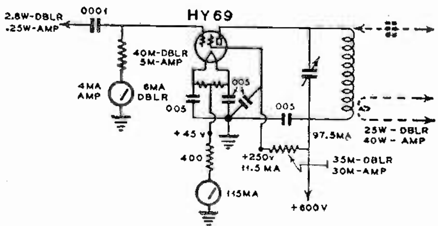
The HY-61/807 Beam Tetrode requires only 0.22-watts drive and delivers 37.5-watts output in the circuit shown.



HY-61/807s in a 75-watt modulator.



HY-69 Modulated Amplifier, 42-watts output. This tube has a separate lead to the beam plates, brought to a prong on the tube base.



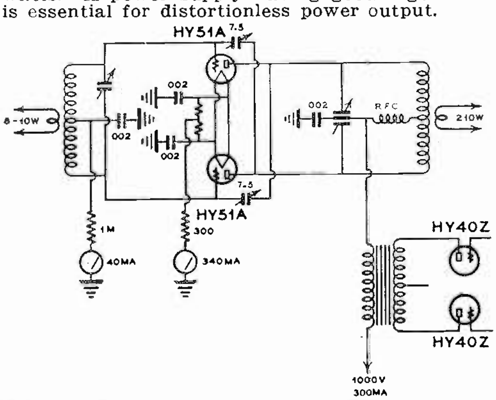
Excellent Frequency Multiplier with HY-69. Circuit gives constants for Buffer or Multiplier.

ENGINEERING APPLICATIONS

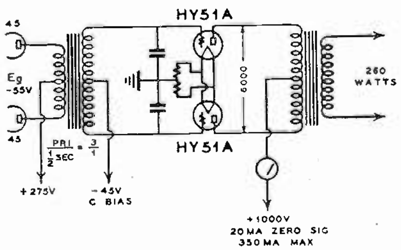
Hytron HY-51A and HY-31Z Applications

cifically for mobile applications, it is equally well suited for AC-operated equipment requiring audio power to outputs up to 50 watts.

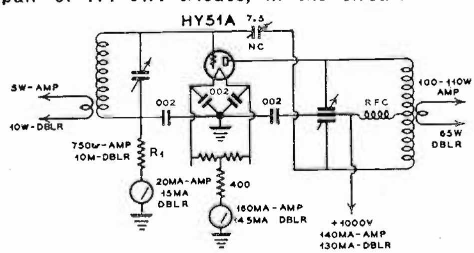
Beam tetrodes, when operated in Class A, AB_1 or AB_2 modulators, have the outstanding advantage of being easy to drive. The HY61/807 is typical of these tubes. The circuit on the facing page illustrates the use of this tube as a Class AB_2 amplifier requiring only a fractiion of a watt driving power for an output of 75 watts. A power supply having good regulation is essential for distortionless power output.



Modulated Amplifier with HY-51As in push-pull. 210-watts output. Only 10-watts drive required.



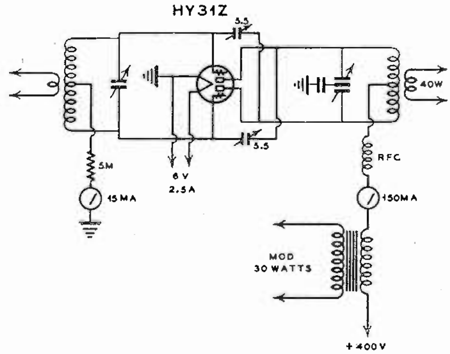
260-watts output can readily be secured from a pair of HY-51A triodes, in the circuit shown.



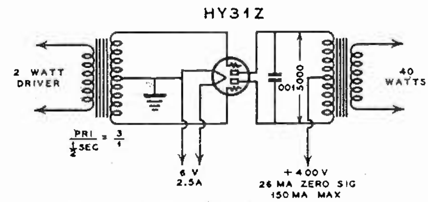
Frequency Doubler or R-F Amplifier with single HY-51A. Doubler output, 65 watts. Amplifier output, 100-110 watts.

PLATE MODULATED R.F. AMPLIFIERS

● Plate modulated R.F. amplifiers are identical



Modulated Amplifier with HY-31Z, 40 watts.



Single-tube zero-bias Modulator with HY-31Z.

to unmodulated amplifiers, except that the plate potential varies in accordance with the audio voltage. Instantaneously on 100 per cent modulation peaks the plate voltage is twice the DC supply voltage, and on the negative peaks the voltage approaches zero in value. Therefore, the circuit must be designed for twice the voltage, and the constants must be adjusted so that the tube will perform satisfactorily at twice the DC plate voltage. It is obvious that considerable more R.F. driving power will therefore be required, and the bias must be such that the tube will operate over the entire range of plate voltages.

Since the max. signal audio power input is 50 per cent of the DC input for 100 per cent modulation, it follows that the plate dissipation of the tube is 50 per cent greater than when unmodulated. For this reason it is often necessary to reduce the DC plate power input when a tube is modulated, and because the instantaneous plate voltage reaches twice the DC plate supply voltage, a modulated stage is usually operated with less plate voltage than an unmodulated one.

In order to obviate this condition, the HY69 tube was designed with a plate dissipation rating adequate to handle the additional audio power input, and this tube can therefore be operated at full input when plate- and screen-modulated. A power output of from 38 to 42 watts is obtainable. In order to achieve optimum performance the screen resistor should be adjusted for minimum distortion at high modulation levels. The value of screen by-pass condenser is critical, and has considerable effect on the modulation capability.

The HY51A type tubes have sufficient power capability to put out a strong signal.

ENGINEERING APPLICATIONS

Hytron U.H.F. Triodes

HY-75 and HY-615

• For frequencies above 60 megacycles (below 5 meters) it is desirable to employ special ultra-high-frequency tubes so that highly-efficient operation can be obtained. Particularly in the case of battery operated units must the efficiency be kept as high as possible in order to conserve battery power, which is always expensive and often hard to get. Experience has shown that high power is not necessary for U-H-F operation. In fact, the world's record for distance on 1¼-meters was made with less than 4 watts in the antenna (HY615 in transceivers). However, for reliable communications it is desirable and often necessary to have available more than the minimum usuable power, and for this reason a larger tube, the HY75, was developed.

When more efficient tubes are used, it means that less DC plate input is required for a given power output, and less R.F. driving power is needed. Because the modulator power required is directly proportional to the DC plate input, it follows that the lower the DC power input the less power output the modulator will require, with a consequent saving in battery drain.

Circuits for Hytron U-H-F tubes are conventional, as shown in the accompanying diagrams. Long lines (parallel bars), or coil-and-condenser combinations, can be employed with highly-efficient results. The HY75, HY114 and HY615 can be used as oscillators, superregenerative detectors, and in transceivers. The HY114 (not shown in the circuits) is a 1.4 volt version of the HY615.

In ultra-high-frequency circuits the location of parts is very important, and can best be determined by experimentation. The customary use of r-f chokes and by-pass condensers does not always hold in the u-h-f region. In these circuits the chokes and by-passes are used to keep the r-f energy in the tank circuit, so that it can be coupled to the antenna. Judicious use of by-pass condensers will eliminate losses due to circulating currents in the chassis, and to standing waves.

With filament-type tubes, such as the HY75 and HY114, it may be necessary to employ filament chokes. The presence of r.f. at the filaments can be detected by scratching the filament socket connections with a lead pencil (in the dark). If a small spark is noticed, r.f. is present, and filament chokes may eliminate this r-f and increase the circuit efficiency.

Note: All ratings for continuous service operation.

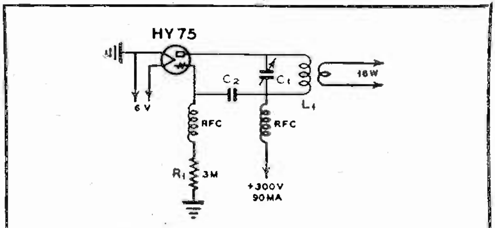
Electrical Characteristics of HY75

Filament	6.3 volts @ 2.75 A.
Plate voltage	450 max. volts
Plate current	100 max. ma.
Plate dissipation	15 max. watts
Mutual conductance	2300 umhos
Amplification factor	10

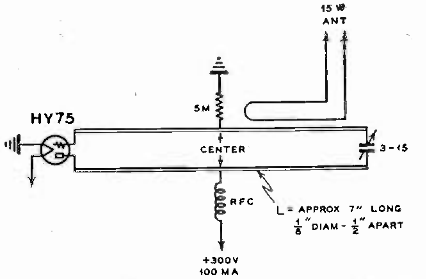
Typical Operating Characteristics

Oscillator and Class C R.F. Amplifier

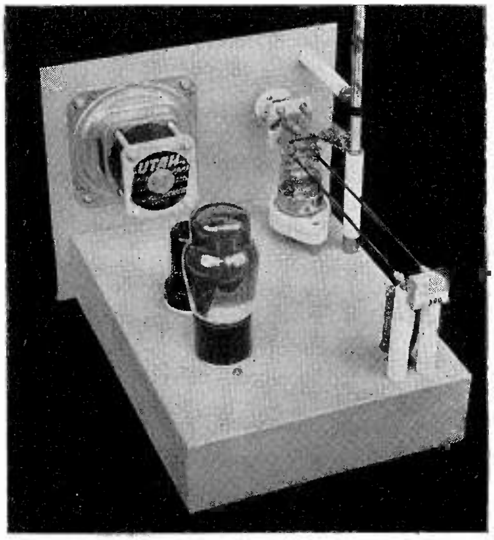
DC Plate voltage	450 max. volts
DC Plate current	100 max. ma.
DC Plate input§	30 max. watts @ 224 mc.
	30 max. watts @ 120 mc.
	45 max. watts @ 60 mc.
DC Grid current	20 max. ma.
DC Grid voltage	–150 max. volts
Plate dissipation	15 max. watts



Typical circuit for 2½- or 5-meters



Parallel-wire circuit for 1¼-meter operation


Suitable design for 2½-meter transceiver

Operating Data for 1¼ Meters

DC Plate voltage	300	450 volts
DC Plate current	100	68 ma.
DC Grid Bias‡	-60	-90 volts
DC Grid current*	15 ma.	15 ma.
Nominal R.F. power output*	15	15 watts

Hytron HY-75 and HY-615 U.H.F. Triodes—Contd.

Plate Modulated Oscillator and Class C R.F. Amplifier

(Values below are for speech modulation only)

DC Plate voltage	450 max. watts
DC Plate current	100 max. ma.
DC Plate input§	24 max. watts @ 224 mc.
	28 max. watts @ 120 mc.
	36 max. watts @ 60 mc.
DC Grid current	20 max. ma.
DC Grid voltage	-150 max. volts
Plate dissipation	12 max. watts

(No modulation—rises to 15 watts when 100% speech modulated.)

Operating Data for 2½ Meters

DC Plate voltage	300	450 volts
DC Plate current	93	62 ma.
DC Grid Bias‡	-60	-90 volts
DC Grid current*	20	20 ma.
Nominal R.F. Carrier output*	16	16 watts

§Maximum plate voltage may be used at any frequency if maximum plate dissipation is not exceeded. Values of plate input given above assume reasonably efficient circuits and operating conditions.

‡Bias and excitation should be adjusted to optimum value for the particular circuit and other constants employed.

*Subject to wide variations, controlled by circuit constants and operating characteristics of associated input and output circuits.

Operating note:

With fifteen watts plate dissipation, the anode of the HY75 shows no color. The presence of a red glow indicates that the rated dissipation is being considerably exceeded; and if such occurs, the plate input power should be reduced or adjustments made in the transmitter to increase the plate circuit efficiency, thereby lowering the value of plate dissipation to its rated value.

HY-114 Characteristics
General Description

Ultra-high frequency 1.4 volt triode oscillator, R. F. amplifier, detector, for portable receivers and transmitters.

Heater Voltage	1.4 volts
Current	0.12
Maximum Overall Length	2-7/16"
Maximum Overall Diameter	1-5/16"
Bulb	T19
Base	Octal 5 pin

Approx. Inter-electrode Cap.
Cgp = 1.7 mmf.
Cgf = 1.2 mmf.
Cpf = 0.6 mmf.

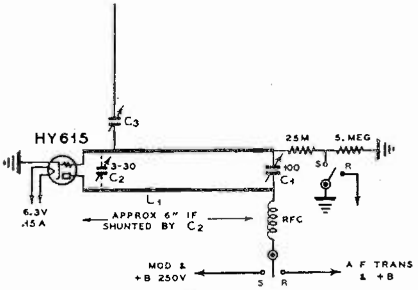
Amplification Factor	20
Mutual Conductance	1000 umhos
Plate Resistance	20000 ohms

R. F. Power Amplifier & Oscillator Class C*

DC Plate Voltage	180 volts max.
DC Plate Current	15 ma. max.
DC Grid Current	3 ma. max.
RF Power Output*	2.0 approx. watts

*At 240 megacycles.

Like the HY615, the HY114 has plate and grid leads brought out to caps in the dome of the bulb. Except for the reduced power rating, the HY114 is equivalent to the HY615. It is, therefore, an ideal tube for portables and transceivers.



Parallel-wire circuit for 2½-meters

Continuous-Duty Ratings used in this table

HY-615 U.H.F. Triode
Physical Data

Plate	Processed Nickel
Grid	Molybdenum-Nickel
Bulb	T-9
Base	Special Octal 5 Pin
Insulation	Ceramic
Plate Lead	Metal Top Cap
Grid Lead	Metal Top Cap
Max. Overall Length	2-7/16"
Max. Overall Diameter	1-5/16"
Net Weight	1⅛ oz.

Electrical Characteristics

Heater Voltage (A.C. or D.C.)	6.3	volts
Heater Current	0.15	amp.
D.C. Plate Voltage	300	volts max.
D.C. Plate Current	20	ma. max.
D.C. Grid Current	4	ma. max.
Amplification Factor	22	
Mutual Conductance	2200	umhos
Plate Resistance	10000	ohms
Plate Dissipation	3.5	watts max.

Inter-Electrode Capacitance

Grid to Plate	1.7 mmf.
Grid to Cathode	1.4 mmf.
Plate to Cathode	1.7 mmf.

R. F. Power Amplifier and Oscillator Class "C" (Plate Modulated or C.W.)

D.C. Plate Voltage	300	max. volts
D.C. Plate Current	20	max. ma.
D.C. Grid Current	4	max. ma.

Typical Operations:*

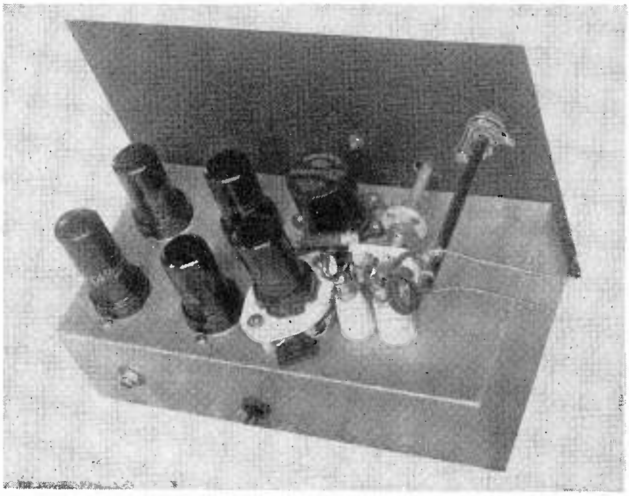
D.C. Plate Voltage	300 volts
Grid Voltage	-35 approx. volts
D.C. Plate Current**	20 ma.
D.C. Grid Current**	1.4 approx. ma.
R.F. Power Output**	3.5 approx. watts

*At 240 megacycles. Only moderate reduction in this value will be found for frequencies as high as 300 megacycles. Above this frequency, the power output decreases as the frequency is increased.

**Subject to wide variations controlled by circuit constants and operating characteristics of associated input and output circuits.

Technical UHF

Simple 2½-Meter R-C Superhet For Better Selectivity

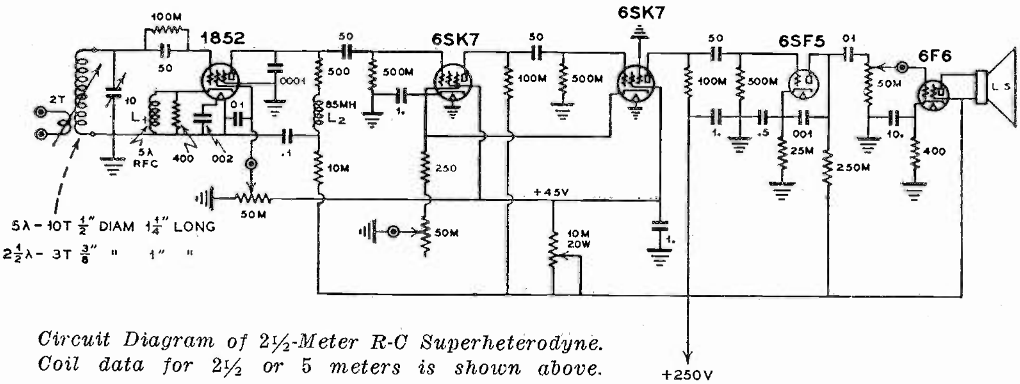


Looking into the complete R-C Superheterodyne.

THE increased activity on the 2½-meter band has resulted in an increased demand for a receiver more selective than the standard superregenerative type.

A conventional UHF superheterodyne receiver with separate tuned oscillator circuit and tuned IF amplifiers is sometimes beyond the constructional ability of many UHF experimenters. The R-C superheterodyne is very nearly as simple to build as a superregenerative receiver, and is far less expensive than a regular superhet. The selectivity of the receiver shown in the circuit diagram is intermediate between that of a superregenerative type and a good UHF superhet.

The autodyne first detector-oscillator has a broadly tuned plate circuit which is resonated near the middle of the broad-band response of the R-C-coupled two-stage amplifier. The tuned plate circuit consists of an 85-mh. old-style r-f choke in series with a 500-ohm resistor to reduce the selectivity sufficiently to allow reception of modulated-oscillator or transceiver signals.



Circuit Diagram of 2½-Meter R-C Superheterodyne. Coil data for 2½ or 5 meters is shown above.

NATIONAL DEFENSE AND THE FCC

(Continued from page 19)

tion. It is necessary for the Commission to inquire carefully into every case reported to its field offices, even though these suspicious wires oftentimes lead to harmless receivers. I will say that most cases of unlicensed operation turn out to be acts of thoughtless or mischievous youth.

It seems obvious that program service should continue pretty much as at present. After all, that is the American system of broadcasting, and distinguishes it from the situation abroad, where broadcasting has degenerated to a system of propaganda, and television has been "blacked out," amateurs rubbed out, and research and progress retarded for more years than we may yet realize. Such chaotic conditions as regards communications must not invade the United States.

Of course, I do not mean to imply that, under actual emergency, the Government might not temporarily enlist particular radio outlets for military purposes, and in the extreme picture, temporarily shut down, say seaboard transmission which might serve as a beacon to an enemy in event of air raids. Also, in an actual emergency, the Government would undoubtedly require certain periods in which to broadcast official bulletins and other public announcements. But that would not necessitate taking over broadcasting facilities bodily. The broadcasters stand anxious and willing to lend their facilities and give time to the nation at stated periods or on other occasions when such need arises.

A collaborative spirit is reflected in all fields of communication. It not only permeates the broadcasting industry, but extends throughout the commercial fields, and into the domain of the amateurs. The amateurs constitute a valuable source of supply of operators and other experts for the military and other services in time of war. Besides cooperating in every particular with the Commission in normal times, the amateur has been of particular aid in the national defense set-up by policing his own frequencies. It may be interesting for you to know that by voluntary action most amateurs stopped communicating to warring countries long before the Commission imposed its general prohibition respecting foreign contacts.

I cannot over-emphasize the fact that action of the Commission in prescribing certain general curbs is *precautionary* rather than *disciplinary*. We are proud of the patriotic and cooperative response of operator and industry both.

UHF Survey (Continued from page 43)

against bootleggers, and the amateurs will take it upon themselves to free the air of all but licensed stations. A word to the wise should be sufficient here.

Second largest mile-point score was made by Mr. A. R. Davis, Jr., W6NJJ, of Berkeley, California. Operating from the Vollmer Peak in Berkeley, he succeeded in contacting 27 stations, scoring 798 mile-points. Unfortunate in not heading the list from the standpoint of total mileage scored, Mr. Davis is nevertheless accredited with the greatest number of station contacts—27 in all. The holders of first and second places in this Test deserve admiration and congratulations for their splendid achievements.

Down in the Southern portion of the State, Mr. Wm. R. Shorethose, W6DOK, located his station on Frazier Mountain. The power input to his two-tube transceiver was 6 watts, the antenna a four-element rotary array. From Frazier Mountain he worked W6OIN in San Diego, 175 miles away, the best DX of any participant. Numerous contacts were made with stations in Hollywood Hills and other points near Los Angeles. It is sincerely hoped that W6DOK will participate in the state-wide tests on November 24th, and that he can persuade a large number of Southern California amateurs to enter the next Test. All stations in Northern California will stand-by during the last five minutes of each hour to listen for DX.

Unfortunate in that they did not place first or second in the inaugural Test, the following amateurs nevertheless are to be congratulated for their splendid cooperation. All were participants.

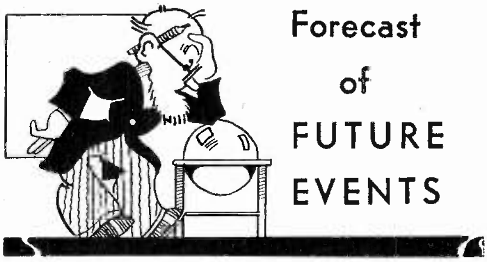
W6ADM, W6BAP, W6BIP, W6BJI, W6BPO, W6CLV, W6CKL, W6EXL, W6GKJ, W6HQD, W6IVN, W6JCD, W6JQV, W6JWF, W6KIW, W6LAS, W6MGR, W6MTJ, W6NCD, W6NGR, W6NJJ, W6NJW, W6OJU, W6OMC, W6PBO, W6PIV, W6PJK, W6PVT, W6PWQ, W6QJK, W6QYG, W6QYV, W6RFL, W6RMO, W6SDF, W6SDX, W6SKK, W9OWW/6.

Send for your Log Sheets and Survey Information for the November 24th Test now.

* * *

CHRISTMAS SUGGESTION

Send "Amateur Radio Defense" as a Christmas Gift to an Amateur friend. Mail your order early!

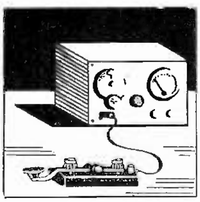


Forecast of FUTURE EVENTS

F. D. Wells is chuckling over the success achieved in his design of a beautiful, compact, inexpensive 10-meter 'phone transmitter for the amateur who will be satisfied with less than 100 watts input. A well-designed, low-power rig will work anything you can hear in these times, and we venture that many amateurs will rush to the workbench when Wells releases his 10-meter material in the next issue. Furthermore, you will get a lot of additional technical advice on the subject matter if you tune-in on W6QUC, because he's on 10 exclusively. Permission to break-in on his day-long QSOs with K6OQM can be secured by addressing both stations!

* * *

In subsequent issues of *Amateur Radio Defense*, several engineers will tell you how to successfully key the various stages of amateur c.w. transmitters. There is much to be told about this subject, beginning with the problem of keying a simple crystal oscillator and ending with the keying of a high-power final amplifier stage. Many test circuits are now being set-up in the laboratory, and as quickly as the engineers complete their work you will find the results of their efforts in the pages of this magazine. We promise you something new, different, and better than the run-of-the-mill variety of keying circuits. Every amateur will welcome this information.

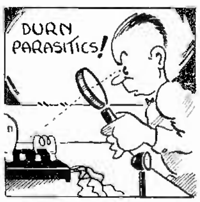


* * *

We have experienced some difficulty in getting press releases from a number of the commercial interests who build compact and portable gear for emergency communication, but word is received as we go to press that two have already weakened and will accede to our request for information. Some of the equipment is revolutionary in design and construction, all of it developed to perform under the most trying conditions. Scoops, scoops and more scoops are in the making. Our only regret is that we can not publish a magazine twice as large in order to satisfy our desire to give you more information. If our national advertisers support us in greater measure, we will soon publish the largest magazine in the amateur field. Several new space-users have already signed contracts, others are waiting to see if we "survive." This magazine has a *mission*, which it will fulfill with vim, vigor and vitality. Although only a month old, its size has already been increased 20 per cent. We hope to boost it to 100 pages next month.

* * *

It may surprise the reader to know that perhaps as many as 95 'phone transmitters in every 100 on the amateur bands are not entirely free from parasitic oscillation. A thoroughly "clean" circuit will produce better voice quality, give higher efficiency, and result in better all-around operation. Frank C. Jones devoted several months of intense research to the subject, then compiled a comprehensive treatise for publication in an engineering textbook. He has consented to give this magazine a "first run" of the material. It is altogether different from anything you have read, and the text includes approximately four dozen circuit diagrams which analyze the type of parasitic, its frequency, its cause, and its cure. This is unquestionably one of the most valuable writings by the author.



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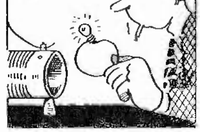
Proper operation of harmonic oscillators of all kinds is another major contribution to the pages of this magazine. A goodly number of new circuits has come to the attention of the amateur in recent years, and all of these ideas will be treated. The entire magazine staff has been put to work on this text. Many oscillators are now being built and photographed. The laboratorians will then give each circuit the acid test and report their findings to you. If you use an oscillator in your transmitter, you will not want to miss this scoop.



TURNER
Microphones
for Efficiency and Dependability

Pep up your rig with a new Turner Mike. Enjoy true broadcast quality, professional appearance and sure-fire performance at low cost. Amateur and commercial users the world over find Turner Mikes answer their most exacting demands.

Model 22X Crystal with Tilting Head

Gain eye-appeal and performance with this new streamlined satin chrome plated mike. Smooth for voice or music. Head tilts full 90 degrees for semi- or non-directional pickup. Cable can be changed without opening mike. Built-in "wind gag"; no blast from close speaking. Diaphragm guard is built in. Large capacity crystal permits long mike lines to be run with minimum loss of level. Inertia type case absorbs mechanical shocks. Crystal impregnated against moisture and changes in barometric pressure. Exceptionally free from feed back. Range 30-7,000 cycles. High level -52DB. Rugged, dependable. Features equal to many $25 mikes. Complete with 7 foot cable set....*List* **$16.50**

Model 22D Dynamic

Identical in appearance with 22X. Rugged construction; dependable performance. With 7 foot cable set *List* **$20.00**

Add $1.50 for 25 foot cable set.

Model 33D Dynamic

Full satin chrome finish of this dynamic mike adds class to your rig. Ninety degree tilting head gives semi- or non-directional pick-up. Twenty-five foot *Balanced Line* removable cable set permits operation under noisy circuit conditions. Output level — -54DB. Range 40-9,000 cycles. Ruggedly built for P.A. or recorder work. Built-in transformer free from hum pick-up. Can take bad climate conditions and withstands rough handling. One hundred ft. lines possible with high impedance unit, and thousands of feet with low impedance

50 ohms, complete with 25 foot cable set...........*List* **$23.50**

200, 500 or high impedance, with 25 foot cable set....*List* **$25.00**

Deduct $1.50 for 8 foot Cable Set.

Model 33X Crystal

Same in appearance as 33D, our finest crystal microphone with semi- or non-directional operation. Professional appearance, rugged, satin chrome finish, with crystal impregnated against moisture. Automatic barometric compensation. Tilting 90 degree head permits operator to speak or sing directly into mike without it being in line of vision. Removable 25 foot cable set. High output of -52 on wide range of frequencies. High capacity crystal permits long lines to be run without frequency discriminations and minimizing loss of level. Response 30-10,000 cycles. Larger, heavier unit than 22X with wider response.

Complete with 25 foot removable cable set........*List* **$22.50**

Deduct $1.50 for 8 foot Cable Set.

Model 44X Crystal Selective Directional

Now you can *choose* the sound you want amplify. Model 44X has 13-15DB differe tial between front and rear pickup, microphone can be considered dead at t back. Eliminates audience noise and bac ground disturbances. Reduces feedback a reflections. Allows operation in acoust ally bad spots. Ninety-degree adjustal tilting head allows non-directional pick Unusually high level -58DB when us with standard 25 foot cable. Lines up to feet may be used with no frequency d crimination and a minimum loss of lev. Range, 30-10,000, cycles. Finished in sat chrome, fits any 5/8-27 stand. Moistu proof crystal, automatic barometric co pensation, blast proof, mechanical-sho proof.

Complete with 25 foot changeable cable set.....*List* **$27.5**

Model VT-73 Microphon Stand and Cable

Double your pow with VT-73, built pecially for voice tran mission. Speech fr quencies emphasized creating a rising curv ture of response b tween 500 and 4,0 cycles. Crisp, clear si nals, even throug QRM. Combinatio microphone, hand and stand, weighs ounces. Anti-resona cable. Climaticall sealed. Fully RF shiel ed. Won't blast fro close speaking. Hi output -50DB. Finish in telephone black and chrome.................*List* **$18.0**

Model 99 Dynamic

Was chosen as Official Mike at W6USA, California Exposition. The most rugged mike we can offer. Gun-metal finish; professional appearance. Output -54DB. Range 40-9,000 cycles.

50 ohm *List*.... **$27.50**

200 ohm, 500 ohm, or hi-imp. *List*.... **$29.50**

Write for Catalog AH Describing Complete Turner Line

The Turner Company

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